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EDITORIAL

COMPETITION OF PRIVATE AND GOVERNMENT ENGINEERS

There are evidently two sides to the case involving the drainage plans of Harris county, Texas, concerning the treatment of which there has been some criticism by engineers involved in the transactions. The U. S. Geological Survey has always been ready to co-operate with governmental organizations in making surveys of areas not already covered by the detailed work of that office and to pay a reasonable share of the cost of the work, usually one-half. So long as the contracts for such co-operative surveys have been made with the states there has been no criticism of them, whether the work was done by the national and state forces in co-operation or was done by either under the supervision or direction of the other, and the cost divided. In the present case the contract has been made with a county, which is a still smaller division than levee districts with which similar contracts have been made, but the principles of co-operation and of expert service with maximum economy are the same.

The criticisms should apparently be made of the county commissioners of Harris county and of the Houston Chamber of Commerce for lack of co-operation, and of the former for advertising for bids for making a topographical map of the county before the negotiations with the U. S. Geological Survey had resulted in a contract.

The county commissioners will also be criticized for attempting to select the engineers to make the survey by a competition on price for doing the work. The range of bids from $40,000 to $190,000 is evidence of at least two things. One is that some of the bidders were not familiar enough with the cost of such work to bid intelligently, some of them greatly over-estimating the cost and others as greatly under-estimating it. The country would suffer in either case by paying too much for the work in the one case, and, most probably, by low value of the work done in the other, or failure of the contractor, to be followed later by a re-letting at a higher price, but few engineers having capital enough to be able to stand a heavy loss on an error in estimate of cost of work or of the quality of work required. The second thing indicated is that some engineers are willing to work for much less compensation than others, and their employes are paid low wages, so that an award to the lowest bidder is almost certain to insure poor work. This is said without any knowledge as to who was the lowest bidder.

This is a case in which, not having the co-operation of the governmental survey, it would be highly advisable that the commissioners choose the best topographical engineer available and put him in charge of the survey, with power to choose his own assistants and methods, and to hold him responsible for the results. But it is, first and foremost, a very proper case, in which to solicit the co-operation of a national organization which has made such co-operation its business for many years, and has demonstrated its ability to secure the desired results. The engineering profession will be in better condition and will have better standing if such competitions as that for the Harris county topographical survey are discouraged by its members.

The employing engineer, the contractor for the work, is the only one who can be benefited specially in any case, and thirteen of the bidders must have had their expense to carry without compensation, so that in the long run, the average of such special benefits may well be less than nothing. So far as nearly all other engineers employed on the work are concerned, their condition is probably better under the governmental employment than under private employment on the same work.

FUTURE BUSINESS

A recent flying trip, almost from the Atlantic to the Pacific, thru the central part of the United States, showed that the spirit of advance is in the air and has begun to demonstrate its presence by the renewal of activity in nearly every direction. Building is particularly active, and large and small buildings are being pushed forward as rapidly as possible in every city visited. Contracts for some of these buildings have been rushed with little preparation for the actual detail of the work, in order to take advantage of present prices, the tendency toward higher prices becoming daily more evident, thus demonstrating the correctness of the arguments made several times during the winter in this department.

Municipal work is becoming active, especially in the smaller cities, and the prospects are for as much work as in any past season, notwithstanding the fact that there is a tendency toward a slight increase in the net interest rates on bond issues. The prospect for higher prices for materials in the near future does not have as much effect in hastening the letting of public contracts as it has in private work.

A few contractors with the ability to retain the advantage of the present prices for materials are holding off until the hungry ones are loaded up, so that they can profit both ways, but most contractors are eager for the work that is offered from day to day. The daily bulletin service of MUNICIPAL ENGINEERING is an accurate barometer of the times, and it is unusually full and valuable at this time.

MUNICIPAL WATER and LIGHT PLANT

OF KANSAS CITY, KANSAS.

By P. W. Morgan, Kansas City, Mo.

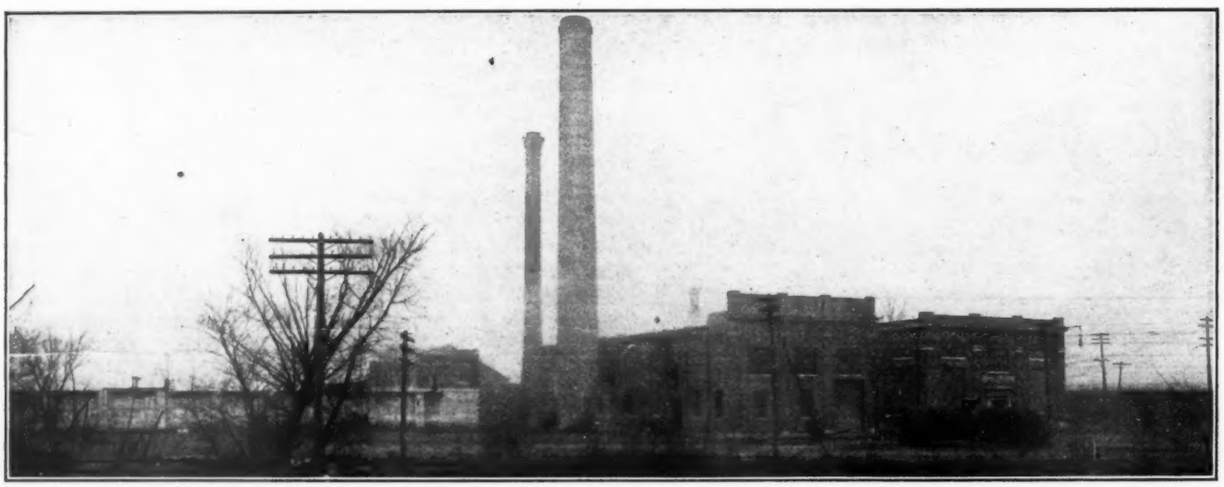
Kansas City, Kansas, began municipal operation of its water plant in 1909 and of its electric lighting plant in 1912. The success of these plants has induced the city to enlarge the electric plant to furnish power and both light and water plants are enlarged from time to time to allow for growth of their business. The author gives a brief history of the plants with some account of their success and states the nature of the improvements which have recently been made and those which are in progress and in prospect. The desirability of continuous expert supervision of such municipal plants may be considered exemplified by the retention of one firm of consulting engineers from the beginning of municipal ownership.

FIVE years of municipal ownership and operation of water works have given the people of Kansas City, Kan., a city of 100,000 population, an abundant supply of potable water for all domestic uses, as well as for all city purposes and for factories, packing houses and railroads. Likewise two years of municipal ownership and operation of an electrical plant, operated in conjunction with the water plant, have given those same people all electrical current needed for lighting and cooking, as well as for illuminating streets, public buildings and business houses, and for power. And it has been a paying investment from the start. Every month of operation of both water and electrical plants has shown revenues earned in excess of all requirements for operating, maintenance, repairs, interest on bonds and a proportional amount set aside as a sinking fund to retire bonds when due.

Kansas City, Kan., is the largest city in Kansas. It has extensive industrial interests, but it is not a wealthy city in the sense of having rich citizens. It is wealthy, however, in the fact that its citizenship is largely made up of industrial workers, and a larger proportion of these people own the homes in which they reside than is found in any other city of its population.

The city first began municipal ownership of its public utilities in 1909, when the people voted $1,097,000 for the purchase of the old plant of the Metropolitan Water Company. The plant was inadequate for serving water to the entire city, having a capacity for supplying only about 8,000,000 gallons daily, and a very poor quality of water at that. To enlarge the plant and build up a thoroly modern system, $400,000 of bonds were voted in 1909 and $500,000 in 1910. With the proceeds of these bonds the city, thru its water commissioners, built a new pumping station and equipped it with new high-pressure Corliss cross-compound condensing pumping engines, and compound condensing duplex pumps, until the capacity for pumping water was increased to more than 30,000,000 gallons daily. Large settling basins, constructed with reinforced concrete, were added to provide ample storage capacity, and nineteen filters, ten of wood and nine of reinforced concrete, provided a filtering capacity for 22,000,000 gallons daily. These improvements, with a new intake in the Missouri river and other necessary equipment, together with the extension of the system of mains and flow lines to reach practically every part of the city, gave Kansas City, Kas., a water system entirely adequate for its present needs and for twenty years to come.

The remarkable success of the venture, not only in the city's ability to supply an abundance of water of the right quality, but in its ability to make the plant pay for itself and to pay all expenses of operation and maintenance, appealed to the people. It was then demanded by them that a municipal electrical system be added and operated in conjunction with the water sys-



THE MUNICIPAL WATER AND LIGHT STATION *of Kansas City, Kans. Electrical plant at the right; water pumping plant adjacent on the left; settling basins at the left of the photograph. The filtration plant is in the background, showing over a corner of the settling basins.*

tem. For this purpose $350,000 of bonds were voted in the fall of 1911.

Altho the water works power plant and pumping station were on the bank of the Missouri river on the Kansas side four miles above the city, it was thought best to combine the water and electrical plants, as it would lessen the cost of operation. The result of this arrangement during the two years the two have been operated together has proved conclusively the advisability of combining public utilities wherever possible.

The electrical plant was first started in November, 1912, supplying the entire city with street lights and about 200 domestic customers. The lowering of light rates, however, and the good service which the plant was able to give, soon made the demands upon the plant greatly exceed the expectations of the most ardent supporters, also the demand for power service was such that in less than a year the plant was overloaded to such an extent that the city in the summer of 1913 voted an additional $200,000 of bonds to double the capacity of the plant and make needed line extensions.

The plant was first built primarily for lighting service and had for the first installation one 500 and one 1000-kw., 2,300-volt, 60-cycle, 3-phase Allis-Chalmers turbo-generator. With the above additional bond issue another 3,000-kw. generator of the same make was installed and provision made for supplying power to private industries.

The domestic service demands during this time had been such that over 4,000 customers had been taken on, and over 1,000 h.p. in power had been served. In the summer of 1914 it was discovered that, owing to the excellent service being given, and the increasing number of new industries being established in the city, the plant could, if enlarged, furnish several thousand horse power, altho the capacity of the plant was ample for lighting purposes for some time to come. These facts, together with the figures showing that the plant was operating at a profit, were submitted to the people, and in August another bond issue of $450,000 was carried by an overwhelming vote of 4 to 1, the proceeds of the bonds to be used as needed to develop the plant to its maximum capacity, limited only by the size of the buildings. A sufficient amount of water works building had been turned over to the electrical department to increase the maximum capacity to 17,000 k. v. a. as required.

In November, 1914, an additional 5,000-k. v. a. Allis-Chalmers generator was purchased and will be in operation during the coming summer. Additional space for another 5,000-k. v. a. generator is provided and probably it will be added in a short time.

Power is being furnished at 6,600 volts thru step-up transformers and provision is being made for supplying 10,000 horse power.

As before stated, the plant was originally built for lighting, but, seeing the advantages of having a power plant as well, and the last bond issue being the largest one voted, it is intended to make the plant up-to-date in every respect, with duplicate service in all parts of the plant.

In addition to the generator to be installed, contract was awarded to the Westinghouse Electric and Manufacturing Company to install a 22-panel switchboard with double bus-bars and electrically controlled switches and all necessary auxiliary apparatus to make the whole electrical installation complete and modern in every way.

The boiler equipment at present for both water and light departments consists of five 350-h.p. Heine, one 300-h.p. B. & W., two 500-h.p. Bonus and two 500-h.p. Murray, a total of 3,700 h.p. Their units are all set 6 feet above the grate and equipped with Jones under-feed stokers. Space for additional boiler capacity of 4,000 h.p. is provided by widening the boiler room and erecting another stack.

The boiler room is now being equipped with overhead coal bunkers, with a total capacity of 350 tons, and a coal and ash conveyor of the overlapping pan type manufactured and installed by the Link Belt Company. Auxiliary boiler room apparatus for the increased capacity recently purchased, to be installed this spring, includes 5,000-h.p. Blake heater, a turbo-driven centrifugal boiler-feed pump, a 6-inch Venturi meter, four 500-h.p. Cappus turbo blowers for auxiliary forced draft.

The electrical plant is now selling approximately 750,000 kw. hours per month and the records show that during the year 1914 the financial results of operation were as follows:

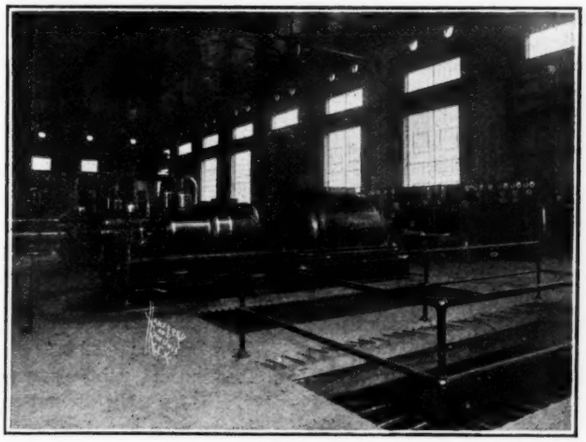
Total income		$169,175.59
Operating expense	$87,644.08	
Interest on $550,000 bonds at 4½ per cent.	24,750.00	
Sinking fund, $550,000 at 4 per cent.	22,000.00	
Maintenance fund, $550,000 at 2 per cent.	11,000.00	
		145,394.08
Net income		$24,781.51

The demand for power and lights is such that in two years time the plant will show a net income of approximately $50,000 per year, and as the plant is entirely for the people a reduction in light rates will be possible after all back expense has been taken care of, such as interest during construction, together with interest and losses during the first year of operation.

A 24-hour test run of the boiler plant made February 2 and 3, 1915, under the direction of Prof. Shaad, of the University of Kansas, showed an operating efficiency of 74 per cent., with the load varying from 750 to 1,850 h.p. during the run.

Under the present administration of Mayor C. W. Green, Mr. L. H. Chapman is Commissioner of Water and Light for the city and he has complete charge of the operation. E. M. Stevens & Co., as consulting engineers of the city, designed the electrical plant from the start and at present are designing and supervising the improvements.

ENGINE ROOM *of municipal electric light and power plant of Kansas City, Kans. Two turbo-generator sets are seen in operation, one of* 1,000 *kv.-a. capacity and one of* 500 *kv.-a. capacity. In the space in the foreground a gencrator of* 3,000 *kv.-a. capacity was recently installed.*



PRICE AND COST OF A ROAD

By H. E. Bilger, M. Am. Soc. C. E., Road Engineer Illinois State Highway Department, Springfield, Illinois.

In this paper presented at the recent short course in Highway Engineering for County Superintendents of Highways of Illinois at Springfield, the author discusses the elements entering into the price which must be paid for a road, including not only the cost, which seems to be considered as the cost of construction, but also the legal and administrative expenses, the interest on bonds, the maintenance of the road from year to year, which make up the price which must be paid, not restricted to the first payment alone, but including the subsequent annual payments of interest and maintenance. The total price paid for the road appears to be paid not alone by the property owner assessed for the first cost but to be shared by the various governmental organizations and their taxpayers.

The author takes occasion to compare the ultimate prices of various pavements and road materials under his definition of price. While comparisons must be worked out for each case and his figures may not apply to any particular case, his discussion is of interest and a study of his methods will aid the engineer in making the comparisons which come into his practice.

IN attempting to present some thoughts for consideration upon the subject, "The Price of a Road," an effort will be made to avoid remarks that would tend to either stimulate or retard the good roads movement; but, rather, an interpretation will be made of the conditions as they actually exist, with a view of inviting attention to proper channels of reasoning in contemplation of highway improvement.

If there is needed any evidence that the reasoning process in connection with highway improvement matters is not always confined within the proper channels, one need only come in contact with the work of some popularly elected officials who supposedly are directing the interests of the tax-paying public in financing, constructing and maintaining the rural highways of America.

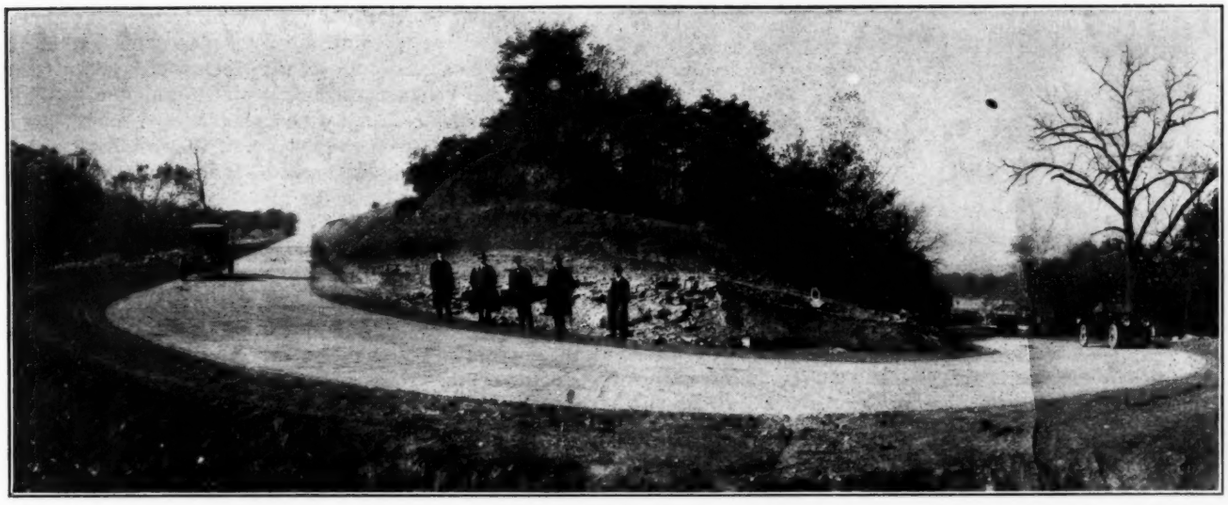
A full appreciation of the situation is hardly possible without having previously obtained an acquaintanceship with the methods employed and the results gotten by our corporations in the direction of their expenditures. However, there will always exist some contrast between the efficiency of the expenditure of private funds and that of public funds. This contrast is not due to its being impossible to obtain for public work men equally qualified with those serving in private work, but the difficulty is inherent in the very nature of a democracy, in that the method of selecting the men, and also their tenure of office, is not such as to promote the highest possible efficiency in the expenditure of public funds.

The highway problem, however, cannot be turned over to a corporation for exclusive management, but it must remain directly in the hands of the people, and consequently be subject to all the influences that are brought to bear by the never-settled public mind. Directly in proportion as the principle of home rule is allowed to prevail will the tax-paying public be obliged to submit to public highway improvement along more or less uneconomical lines.

Not until one has had some years of experience with the rural highway problem is it possible for him to realize how meager, indefinite and unclassified are the data upon which his assumptions must be made for computations in directing the expenditure of capital. If the general tax-paying public could be brought to realize the actual facts of the case, public expenditures would more nearly approximate in efficiency the expenditures of private capital.

The purpose of this paper is not to present any definite data with regard to any particular type of road, nor with regard to any particular expense of operation in connection with the highway problem in general. Each specific highway problem constitutes a case of its own, and as such requires individual treatment. There are, moreover, certain general principles in harmony with which the specific treatment will be administered for any particular highway problem, or phase thereof. It is to these general principles that the following consideration will be confined, with the idea of attempting to invite the attention of the tax-paying public to the real price of a road.

It will be necessary at the outset to appreciate the distinction between the meanings of the terms, "price" and "cost." The cost of an article or piece of work may be defined as the sum required to produce it complete ready for consideration by the consumer; whereas, the price is the total sum given in exchange by the consumer for the complete ownership and use of the article or piece of work. In reference to construction work, the cost is frequently spoken of as the actual cost, meaning the actual expense that has necessarily been incurred in the construction without any allowance for profit. Cost and actual cost in this paper are synonymous, and mean the actual construction expense or its substantial equivalent. The term price let us understand to mean the sum that is actually paid by the tax-paying public, without any regard to the items of expense or to the time of payment. The measure of the cost will be largely a function of the ratio of supply to demand of labor, material, etc., while the measure of the price will in addition be a function of the condition of the money market. It will be noted that with respect to highway improvement, the price is always greater than the cost, and that in general the sum of all the cost items, plus a certain more or less indefinite constant, equals the price—that is, the total expense to be met by the tax-paying public. With these definitions in mind, it will be seen that the price of a road is made up of the following, namely: construction cost, interest cost, upkeep cost and depreciation cost. The character of the construction cost is more or less understood and appreciated by the general public. The interest cost is not sufficiently appreciated by the public to enable the problem to be economically worked out. It matters not whether the funds required for the construction are procured by long-term bond issues, or whether they are raised by present taxation, the fact remains that the capital invested has an almost definite money-making value, and, consequently, this annual



CONCRETE ROAD *near La Salle, Ill., eighteen feet wide and on seven per cent. grade. The "hair-pin" bend is nearly a half circle and the curve is reversed in the background at the ends of the tangents, making the total curvature* 309 *degrees. This road was built under the supervision of the Illinois State Highway Department.*

value must be taken into consideration in determining the price of a road.

The upkeep cost is the total expense necessarily incurred to preserve the improvement in serviceable condition until such time as an entire reconstruction is necessary. It will be seen that the upkeep cost is the sum of the costs for such items as strict maintenance, repairs, resurfacing and partial reconstruction.

The depreciation cost is properly an item that enters to make up the total price of a road. While this cost is a vital factor in connection with the manufacturing world, the use of machinery, etc., yet it is very seldom considered by those having to do with the direction of the expenditure of capital for highway improvement. Highway engineering as yet falls so far short for even approximating an exact science that it would appear almost folly to attempt to consider the depreciation cost in its contribution to make up the price of a road, until more progress has been made in adapting road types to traffic requirements, and establishing adequate and economical systems of upkeep. We are scarcely warranted at this time in going so far as to consider the depreciation cost while we are falling so far short of economically handling the costs nearer home, such as costs for construction and upkeep. The uncertainty of traffic requirements, even in the near future, is such as to demand our concentrated energy upon problems nearer home that at least appear to be susceptible of ultimate economical solution. For this purpose, therefore, it will be considered that the construction cost, the interest cost and the upkeep cost, all combined, constitute the price of a road.

In the light of the present road situation in Illinois it will be interesting to consider, so far as available data will permit, the probable price to the tax-payers of our three popular types of road, namely, vitrified brick, Portland cement concrete and water-bound macadam. During the latter half of the year 1914 the Illinois Highway Commission entered into contract for the construction of eighteen vitrified brick roads, aggregating 114,188 square yards, in 17.7 miles, and located in eleven counties. During the same time contracts were entered into also for the construction of fifty-seven Portland cement concrete roads, aggregating 539,933 square yards, in seventy-five miles, and located in thirty-seven counties. From having awarded these contracts we are practically assured that if we exclude such items as rough grading, bridges and culverts, and the like, the brick pavement proper can be built at a construction price to the tax-payers of $1.90 per square yard, and the concrete pavement proper at a corresponding price of $1.20 per square yard, where the haul does not exceed about two miles. Excluding, for comparative purposes, the expenses incurred for rough grading, bridges and culverts, etc., let us consider the approximate price to the tax-payers of the brick, concrete and macadam roads. For the brick road we have a construction cost of $1.90 per square yard. Assuming the issuance of twenty-year serial bonds, payable annually, and rating interest at 5 per cent., the interest cost on this $1.90 is $1.00. From the experience that various cities thruout Illinois have had with vitrified brick pavements, we are reasonably well assured that the total upkeep cost on the pavement proper for the first twenty-five years would not exceed an average of one cent per square yard per year. These three costs give us a price to the tax-payers of $3.15 per square yard for a 4-inch vitrified brick pavement for the first twenty-five years. As mentioned before, the depreciation cost, with respect to so-called permanent highway improvement, is such an excessive refinement in this day as not to warrant much consideration, providing the construction, interest and upkeep costs are duly considered.

For the concrete pavement we have a construction cost of $1.20 per square yard. Computing interest as before, we get an interest cost of 63 cents per square yard. In the probable upkeep cost for the concrete pavement is where the greatest uncertainty lies. One would be presumptuous, indeed, to assume that under our mixed traffic conditions the concrete pavement would endure longer than some fifteen years without economically admitting of a resurfacing. From present knowledge it would appear that the most practicable low first-cost resurfacing for a concrete pavement, unevenly worn, would be a bituminous concrete some three inches in average thickness. Considering the necessarily high quality that this surface would need to be, it is quite likely that its application would incur an expense to the taxpayers of as much as 75 cents per square yard. To meet this expense, if we issue five-year serial bonds, payable annually, and computing interest as before, we get an interest cost of 11 cents. But in addition to this, the pavement would need what might be termed strict maintenance thruout the 25 years. From our present knowledge of this type of construction, we are not warranted in estimating that this strict maintenance cost

BRICK ROAD *near Monmouth, Ill., built under the supervision of the Illinois State Highway Department. The brick pavement is ten feet wide and has concrete curbs. The grout filler is being placed in the foreground.*

would be less than 2 cents per square yard per year, making 50 cents for the 25 years. These four costs, namely, construction cost, $1.20; interest on same, 63 cents; resurfacing cost with interest, 86 cents; strict mantenance cost, 50 cents, total up to $3.19 as the probable price to the taxpayers for the concrete pavement proper for the first 25 years.

For the macadam pavement we are warranted in saying that under conditions similar to the foregoing, its average construction cost would be about 75 cents per square yard. On this 75 cents the interest cost would amount to 39 cents. It is quite probable that where macadam as a type would appear on the face of the situation to prove a feasible proposition, its total upkeep cost per year for the first 25 years would not exceed 5 cents yer square yard, making a total upkeep cost of $1.25. These three costs, namely, construction cost, 75 cents; interest cost 39 cents, and upkeep cost, $1.25, total up to $2.39 as the probable price to the taxpayers of a macadam road for the first 25 years. Summarizing we get the following prices per square yard to the taxpayers for the first 25 years: Brick, $3.15; concrete, $3.19; macadam, $2.39.

It becomes interesting to consider this matter a step further. For the macadam pavement, the sum of the construction and the interest costs amounts to $1.14. Deducting this amount from the total price to the taxpayers of a brick pavement, we have $2.01 as the amount that would need to be spent on the macadam pavement during the first 25 years, in order to make the total price to the taxpayers the same as that for brick. Without question there are many counties in Illinois where the total upkeep cost on a macadam pavement for the first 25 years would considerably exceed $2.01 per square yard, and consequently, under these conditions, the macadam pavement could not be considered the economical type. There are many other counties in Illinois, moreover, where the conditions are such that the total upkeep expense per square yard on the macadam pavement for the first 25 years could not reach $1.00, and, under these conditions, the tax-paying public will do well to look deeply into the real economics of the various types of construction before committing their expenditures to the so-called fool-proof types.

Under present conditions, however, we are warranted in adopting types of construction that run higher in construction cost than the foregoing mathematical consideration would seem to justify. One reason for this is because of the rapidly changing character of our traffic conditions. The service demanded of our public highways is growing more sereve each year, so in anticipation of more exacting traffic requirements expenditures for highway improvement must be directed by considerations looking somewhat into the future. Another reason why we are warranted in adopting a higher type of construction than would seem to be justified, is that the types most expensive in construction cost presuppose the existence of a methodically handled and economically administered system of maintenance, which has not yet been developed in Illinois. Until such a maintenance inauguration has taken place, wisdom in expenditures for road improvement would seem to suggest that the types least expensive in construction cost should be avoided, unless their economy seems assured by at least a fair preponderance of evidence.

The price of a road, moreover, cannot be measured by monetary considerations alone. Entering into the problem there are other factors to which no tangible value can be assigned, yet they contribute with the monetary consideration in making up the price of a road. When once the will of the people has become favorable toward road improvement in general, the battle is practically won, but during the development of this favorable sentiment there is being paid a price that never appears on the finished road.

MACADAM ROAD, *twelve feet wide, with earth road at the side, near Sheldon, Ill., built in* 1909 *under the supervision of the Illinois State Highway Department.*

Legal Peculiarities of Arkansas Improvement Districts

Kirby's Dig., Sec. 5675, provides that in case of the construction or acquisition of water works by any improvement district, or districts, the city or town council, after such works are constructed, shall have full power to operate and maintain and may supply water to private consumers, making uniform charges for such service and applying the income to the payment of operating expenses. An improvement district which did not include the whole of the municipality acquired a water works. The water supply was more than sufficient for the needs of the improvement district, and another portion of the city organized itself into an improvement district, laid mains to connect with those of the first district, and prepared to purchase water. *Held*, That while the city which controlled the water works could not do any act detrimental to the interests of the district owning the plant, it might under the statute sell water to consumers residing in the second district, that being for the benefit of the first district because increasing its income.

That the supply of water might in time become insufficient to supply the second district is not ground for restraining the city at the present from supplying persons in the second district.—Armour v. City of Ft. Smith (Ark.) et al., 174 S. W., 234.

CHICAGO'S MUNICIPAL REPAIR SHOP

By C. C. Saner, C. E., Chicago, Illinois.

In a large city, repair shops for the various departments are very necessary and shops of considerable size have been developed in Chicago in water, fire, police and street departments. Equipment is duplicated in these various shops and frequently labor is lost because no one shop has work enough to keep one man busy on some special work for which a competent man must be on call. Some one has conceived the idea that Chicago could save money by concentrating all its repair work in a single shop, and the result is the central group of municipal shops described in this article. Probably each pumping station, fire or police station or garage will still have its bench with facilities for small repairs but those of any magnitude are expected to go to the central shop. Whether the concentration of the shops and probable reduction in cost of labor, power and interest and depreciation on duplications of original equipment under the old system will offset the loss of time and cost of transfer of apparatus, etc., to be repaired and of repair parts to be taken out of stationary machinery and put back again, not to speak of delays in putting the machinery back at work is to be determined when the plant has been in operation two or three years.

CHICAGO'S first pumping station, constructed in 1853, contained pumping equipment of 8,000,000 gallons capacity per day. The water works system has been developed until to-day, sixty-two years after the first station was constructed, there are nine pumping stations, with a capacity of 840,750,000 gallons per day from forty-two pumps. To furnish steam to these pumps, all but two of which are steam driven, requires sixty-two boilers, with a rating of 15,344 boiler horse power.

The distribution system at the end of 1914 included 2,524.11 miles of pipes of all sizes, 26,984 fire hydrants and 22,716 gate valves of all sizes.

As this system grew it was necessary to establish repair shops to maintain the engines, boilers and buildings, also to manufacture and repair tools. As in any fast growing concern, the shops have been developed at different locations as space could be acquired.

Parallel with the growth of the water department the fire and police department have grown and developed shops for repairing fire-fighting apparatus and police patrols, ambulances, etc. The following shops are located in separate buildings thruout the city: Water works, fire, police, meter, and carpenter and sheet metal. These shops have been compelled to increase their output each year, until each is badly crowded. and the need of new quarters to place them in one group of modern buildings was taken care of by the purchase of land in 1913 and the starting of the erection of buildings in 1914.

The work done by the different shops is as follows:

The water works shop repairs all machinery in pumping stations, manufactures all fire hydrants used in the city and all valves up to 12 inches in diameter. In connection with the present shop are a brass foundry, blacksmith shop and pattern shop.

The fire department shop repairs all fire-fighting apparatus, including fire tugs. As the shop is located about one-half mile from the river, the cost of repairs on the fire tugs is high. This shop has an extensive carpenter and paint shop in connection with it, also a harness shop and a fire alarm telegraph shop.

The police department shop repairs all patrol wagons and ambulances, also manufactures automobile patrols. This shop also contains a carpenter and paint shop.

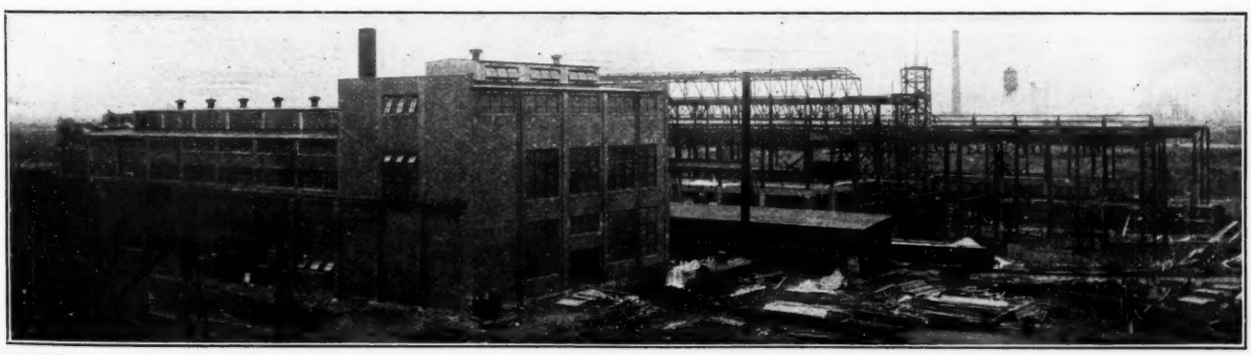
The meter shop tests, repairs and sets all water meters.

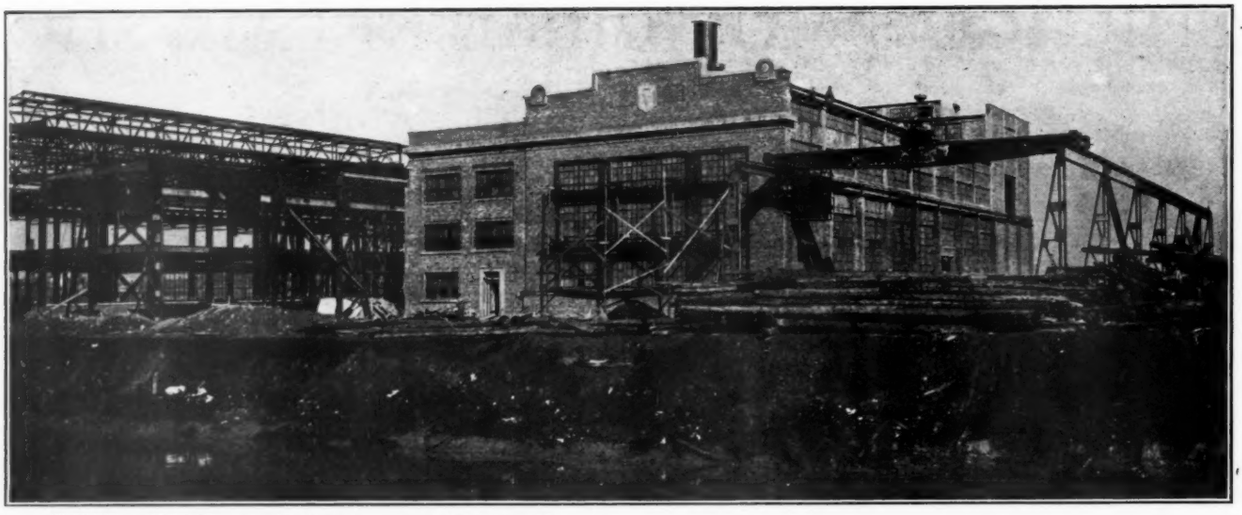
The carpenter and sheet metal shop makes all repairs to city buildings.

The shops are located on city property on the west fork of the south branch of Chicago river and a collateral channel connecting with the Chicago drainage canal, the latter running along the south boundary of the property, with a railway right of way between.

The machine shop, blacksmith shop and foundry, shown

EAST FRONT *of Chicago's municipal foundry, photograph taken March* 20, 1915. *Beyond is the frame of the machine shop and at the right of the main building of the machine shop is the frame of the blacksmith shop as located at present. On the extreme left, outside the foundry, is the traveling crane, one track being on the foundry wall and the other on the steel frame shown.*





WEST FRONT *of Chicago's municipal repair shops. The brick building is the foundry, with its traveling crane over the storage yard for flasks on the right. The frame of the machine shop is seen on the left. In front will be the dock for the municipal repair plant and the industrial railway serving the dock and all of the buildings.*

under construction in accompanying photographs, are arranged along the west side of the lot, far enough back from the dock line on the collateral channel to give room for one line of the industrial railroad serving all the buildings. Next north of the machine shop will be located the garage and office building. The warehouse shown in one photograph is near the southeast corner of the lot, and the carpenter, pattern and paint shop will be located north of it and southeast of the foundry. The plant is located at the intersection of the lines of South Sacramento and West Thirty-first streets produced.

The buildings are so designed and arranged that extensions can be made easily. Two railroad connections will be made to facilitate handling of materials to and from the work. A concrete dock is under contract for that portion of the grounds along the collateral channel, thus allowing the fire tugs to tie up for repairs within a few feet of the machine shop. A complete sewerage system for both sanitary and storm purposes has been installed.

The shops have been so arranged and the industrial railroad so laid out as to facilitate the work and make the minimum amount of handling of the patterns from the pattern shop to the foundry and the casting from the foundry to the machine shop and thru the assembly rooms. A vast amount of repair work will come to the plant and will be placed in the machine shop or in the carpenter shop, as the nature of the repair requires.

The foundry will have a capacity of twenty tons of iron and three thousand pounds of brass per day. Two outside cranes are provided, one for handling flasks in the flask storage yard and one for unloading and handling iron and scrap metal. Two cranes are provided in the iron foundry and one in the brass foundry. All the latest equipment for modern foundry practice is provided. The welfare of the employes is taken care of in ample locker rooms, provided with shower baths and the best toilet facilities.

The machine shop and blacksmith shop are so constructed that when it is necessary to enlarge the machine shop the bay separating the machine shop and blacksmith shop will be filled in and the area between the blacksmith shop and north wing extended and roofed over, making a complete machine shop 308 feet long. As planned at present, when such an extension is made a new building will be constructed for a blacksmith shop.

The main shop of the machine shop will contain the heavy machine tools for working on large castings. All the modern tools in the present shops will be moved and about $25,000 worth of new tools are now under contract. A 25-ton crane, with a 5-ton auxiliary hoist, will handle all heavy castings and machines in the main shop. The south wing, first floor, will contain the tools for manufacturing hydrants and valves, small jib cranes being provided to facilitate handling. The north wing, first floor, will contain the hydrant and valve assembly room and automobile and fire-fighting apparatus repair room. The second floor, south wing, will contain the meter shop for repairing and testing meters. The second floor of north wing is unassigned at present.

A four-story reinforced concrete warehouse, in which city supplies and records will be stored, is nearing completion. Just north of the warehouse a four-story reinforced concrete building of the same type will be constructed. This building will contain the carpenter, sheet metal, pattern and paint shops and the pattern storage. These two buildings will be as nearly fire-proof as it is possible to make them. Metal sash and wire

INTERIOR OF CHICAGO'S MUNICIPAL FOUNDRY, *with traveling crane over the molding room for handling patterns, flasks and materials.*

glass are used thruout and sprinkler systems will be installed.

To the north of the machine shop the administration, laboratory and garage building will be constructed. The main offices for the plant will be located in this building and 8,000 square feet will be assigned to the testing laboratory. The testing laboratory tests all the coal used by the city, also lubricating oils, cements, steel and any other material entering into construction or that are bought on a test basis. The garage will have a capacity of forty trucks, and will contain a vulcanizing plant and room and equipment for making repairs that do not require the machine to go to the machine shop.

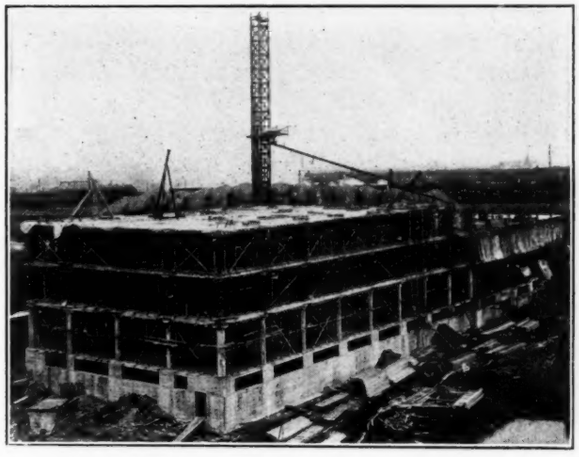
As this plant is located adjacent to the Bridewell grounds, and as a contagious disease hospital is being constructed on the eastern part of the new piece of property, it has been decided to combine the power houses of the shops and Bridewell and furnish heat, light and power to all the buildings from the one plant, using Bridewell labor for construction and to a great extent for operation. The details of this plant have not been worked out yet, but will be completed soon.

The plant will operate as a division in city work, all departments now operating repair shops ceasing to maintain their shops. Requisitions will be made by all departments for all new work or repairs, as it is the aim to eliminate all duplicated shops and have one shop under a well-organized, efficient management.

All the work, with the exception of the dock, is being done by city day labor, under the direction of Mr. H. W. Clausen, engineer of water works construction, and Mr. W. H. Dean, assistant engineer in charge. The design of the buildings is under Mr. M. B. Reynolds, engineer of water works design. Mr. John Ericson is city engineer in charge of the work.

The total estimated cost of the complete improvement, not including the contagious disease hospital, is $1,755,000.

MUNICIPAL WAREHOUSE *in connection with Chicago's municipal repair shop, a four-story reinforced concrete structure for storing city supplies and records.*



TOLEDO SWIMMING POOL

The swimming pool in City Park, Toledo, Ohio, shown in the accompanying photograph, is 180 feet by 60, and from 1 to 4 feet deep, with two basins. A walk 12 feet wide surrounds the basin. The beautiful location, the building for dressing rooms, the fountains, are all well shown in the photograph.

The pools were designed by F. E. Wirebaugh, engineer for the Board of Park Commissioners; Schillinger Brothers Company, of Toledo, were the contractors, and Medusa waterproofing was used in walls and floors. There are similar pools in Navarre and Riverside parks. These pools were completed about five years ago and are in excellent condition, no leaks having developed. We are indebted to the Sandusky Portland Cement Company for the photograph.

WOOD FIBER AND ASPHALT AS PAVING MATERIALS

STAFF ARTICLE

Wood block has an enviable reputation for durability and noiselessness in pavements. Asphalt long ago demonstrated its value as a paving material. The pavement described in this article is more nearly noiseless than wood block and is less slippery than asphalt. A combination of two excellent paving materials, it may, like other "Burbanked" products, combine the good qualities of both and leave out the less satisfactory qualities of both. This is the first real pavement laid with it and it is believed to be of enough general interest to warrant this description of the process.

THE city of Charleston, W. Va., is a pioneer in the introduction of paving materials. It is stated definitely that the first bit of brick paving laid in this country was a few square yards laid by a merchant in Charleston before his store, in 1870, which proved so successful that it was extended in 1873 over a considerable length of street. Part of this pavement, including the original bit, was taken up and relaid with bitulithic about 1910, and the remainder has just been torn up to be relaid with bitulithic this year. It was laid on tarred boards, surrounded with a sand cushion, a foundation which proved remarkably durable, as the boards are still in fair condition after more than forty years in the ground.

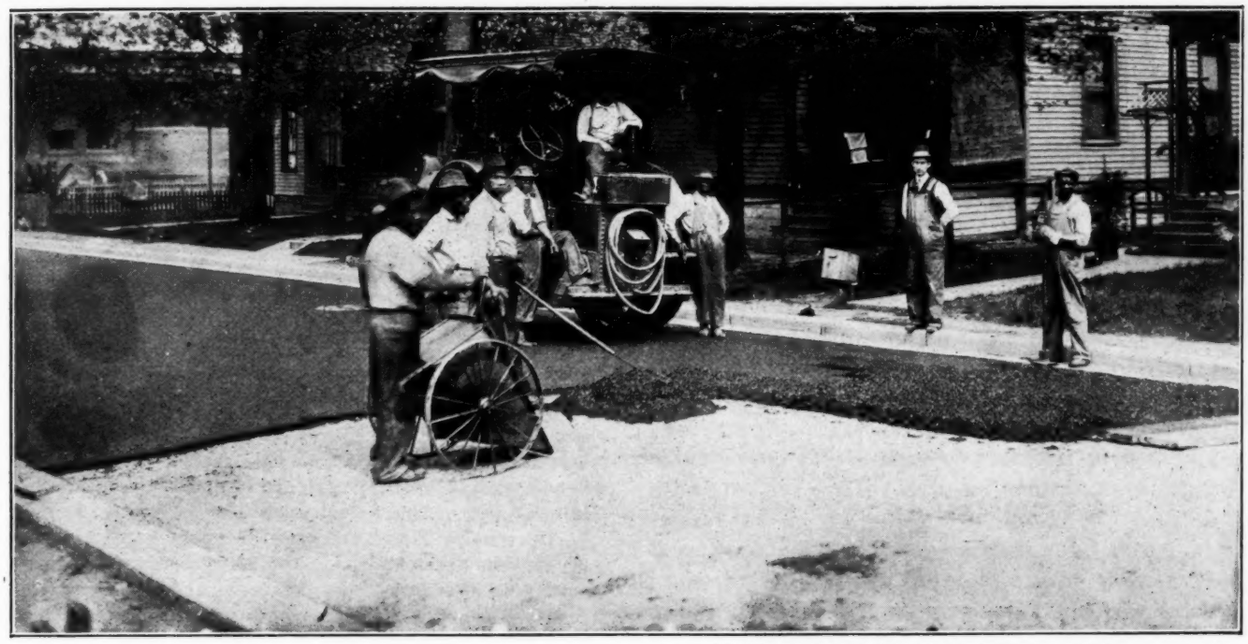
The city has just laid the first pavement of a new design and composition of materials which was first tested on a short but heavily traveled section of street in Memphis, Tenn., thru three winters and two summers, and on some small areas of street repairs thru a summer and winter.

Morris street, on which the new pavement is laid, is one over which the traffic to and from freight depots passes on its way down town, and over which, at the present time, there is a large amount of hauling of materials for street, sidewalk and sewer construction, of which the city is doing a large amount this year. The pavement is 605 feet long, with a residence street entering it from one side near the middle of its length and at the top of the grade, which slopes down in either direction, the maximum gradient being 1.38 per cent. down in the direction of the heaviest traffic.

The pavement is 27 feet wide and is laid between combined curbs and gutters of concrete, the gutters being 18 inches wide and the curbs 16 inches thick. It is laid on a 5-inch concrete foundation, part of it of broken stone being rather irregular in its surface, but most of it of gravel, with uniform surface with some roughness. The crown of the street is quite high, especially for the gradients of 1.38 per cent. in one direction from the center, and 0.5 per cent. and less in the other, the crown and the gradient both insuring rapid removal of water from the pavement. While the traffic test of the pavement will be rather severe, the other conditions are favorable.

The pavement itself is composed of wood fiber of proper size, mixed with asphalt and a proportion of stone dust or other mineral matter, heated and mixed in a Hetherington & Berner road plant of a new design, and laid and rolled in place in a single layer. Most of the pavement is laid with Trinidad asphalt, but a small area in the center contains a mixture of Trinidad with Aztec. The plant for laying the pavement is an important factor in securing the desired product.

ROAD PLANT *for laying bituminous pavements in operation, laying fibered asphalt pavement in Charleston, W. Va. Dryer is fitted for wood fiber. Asphalt melting tank is in position to serve by weighing bucket the mixer seen under the hopper for weighing fiber into the mixer. Screen in top housing rejected the fiber too large for use seen in the pile beside the machine.*



LAYING AND ROLLING *fibered asphalt pavement on concrete base.*

One of the accompanying photographs gives a view of the plant in operation. A traction engine pulled it into place on the street entering the street to be paved near its middle point, so that it was located conveniently for delivery of the material to the street in hand carts. This engine is shown operating the plant machinery. Immediately to the left of the plant is a pile of bags of the dried fiber, the bags being emptied into the box in which a man is sitting, feeding the fiber to the elevator, a series of buckets on an inclined belt, of which only the lower end is seen. This elevator discharges into the dryer in which the fiber is heated, in such manner as not to come in contact with flame or hot gases. A vertical elevator, the top of which is seen at the top of the machine, discharges the fiber into a screen, which is readily set to reject any size desired. This screen discharges into a bin, the rejected large particles dropping thru the tube shown into a pile on the street.

The asphalt is melted in the kettle on the right and may be aided by another kettle, the end of which is seen on the extreme right. Fiber is dropped into the hopper above the mixer to a definite weight, a weighed quantity of stone dust is thrown into the mixer with the fiber and a weighed quantity of hot asphalt. After sufficient mixing to insure thorough coating of the particles of the aggregate, the mixture is discharged into the cart below and carried to the street.

A second photograph shows a cart which has just dumped its load, which is being raked into place and immediately compressed under a heavy roller. The possibilities of rolling without supporting planks at the edge of the layer, and of producing a smooth, even surface, are clearly seen in the photograph.

The completed pavement is very resilient and is practically noiseless, a very dull thud from the beat of the horse's hoofs being the only sound.

There are many special points of advantage in both machine and pavement which have not yet been made public, but the results of their operation are apparent, and indicate a successful pavement as to durability, cleanliness, noiselessness, absence of slipperiness, smoothness and sanitary qualities.

We are indebted to F. A. Hetherington, of Hetherington & Berner, Indianapolis, Ind., for information concerning the paving plant, which is applicable to other asphalt and asphalt macadam paving, and to the Wood Fiber Asphalt Company, of Charleston, W. Va., for courtesies in giving opportunity to observe the construction of the pavement, and to the Central Engineering Company, of Charleston, for photographs of the paving plant and the street. The latter company are the contractors laying the pavement.

NEWLY-LAID *fibered asphalt pavement. At the right next the gutter shows a strip of the original mixture after receiving its first rolling. Next to the left is an irregular strip to which the squeegee coat has been applied. The whole of the remainder of the street to the left is covered with stone screenings ready for final full rolling.*

FINISHED FIBERED ASPHALT *pavement ready for traffic.*

Making Ice with Purchased Electric Power

By Charles A. Tripp, Consulting Engineer, Indianapolis, Ind.

The possibilities of the manufacture of ice using commercial electric power are demonstrated by the plant described in this article, which is abstracted from a paper before the Indiana Engineering Society. If so much of a success can be attained by purchasing electricity at the price obtainable if it is used when the load on the generating station is light, it would seem that electric light stations which are sufficient in capacity to carry their peak loads could engage in the ice business with profit. Some are doing so. Some recent decisions have thrown doubt on the legality of municipal plants engaging in the ice business in some states, but economy, reduction in cost of electricity and consequent reduction in rates, sanitation, especially in southern small cities where ice is much desired and much needed but is unattainable at reasonable prices, are all arguments in favor of legislative action, where it is needed, which will give such cities the power which their cousins under private ownership already have. This article is of interest, therefore to many operators of municipal plants as well as to operators and owners of private electric light plants.

THE use of electricity in the manufacture of ice is one of the varied uses of central station power, which, under recent developments, offers great possibilities for both the public service company and the ice manufacturer.

From the standpoint of the central station the load is ideal. It is not only "off peak," in the sense that no power need be used between the hours of 4 and 6:30 from November to February, but the yearly load curve corresponds closely with the average central station curve, with the peak in July instead of December. This is shown by the accompanying diagram, which shows a typical central station load curve and a typical ice plant load curve. If the ice plant load is made such that when added to the typical central station load it produces a peak in July equal to the peak in December the "combined" curve is obtained—a load curve of which any central station manager could well be proud.

While this ideal balance is doubtless unattainable, nevertheless any load of this character is one which should be warmly welcomed by the public service company.

Until within the past few years electric power labored under a serious handicap in this field, on account of the fact that distilled water was required, calling for a boiler plant, and steam. The development of the raw water system, or the manufacture of clear ice from undistilled water, has removed this handicap, and given electric power an opportunity to come into its own in this industry.

The plant of the Irvington Ice Company is operated entirely by central station power. The buildings are of brick with steel sash and doors, concrete floors and reinforced concrete roofs. The office is located in the first story of the tower. The ceiling is a waterproofed concrete slab with drain openings above. The tower above the office contains the water tanks. The ice storage rooms are insulated with cork board and finished with cement plaster. The fact that the insurance rate on this building is 10.8 cents is a testimonial as to its fireproof character. No insurance is carried by the owners.

A plant of this character may be divided into three sections: (1) Ammonia Compression and Condensing; (2) Freezing and Storage; (3) Water Supply.

The compression and condensing equipment consists of two 11½ by 15-inch two-cylinder single-acting vertical compressors, each driven by a 50-h.p. motor. One of these motors is of the standard squirrel cage type for constant speed operation, and the other of the slip ring type, with controller for variable speed. Both of these motors are equipped with autostarters, with no-voltage and overload release. This arrangement makes the starting and stopping of the slip ring motor independent of the speed control. The speed controller and resistance is located at the left of the switchboard.

The condensers, as shown in Fig. 2, are placed directly behind the compressors. These consist of two 8-pipe sections of the Shipley double pipe type. The cooling water passing thru these condensers is controlled by Sylphon automatic valves. These are standard hot water tank regulators, except that the valves are reversed so that a rise of temperature causes them to open intsead of close. The thermostatic bulb is placed in the water discharge pipe. The volume of water

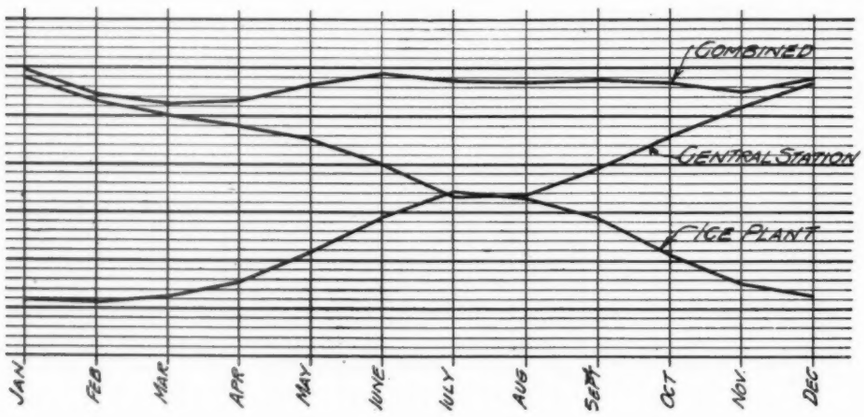
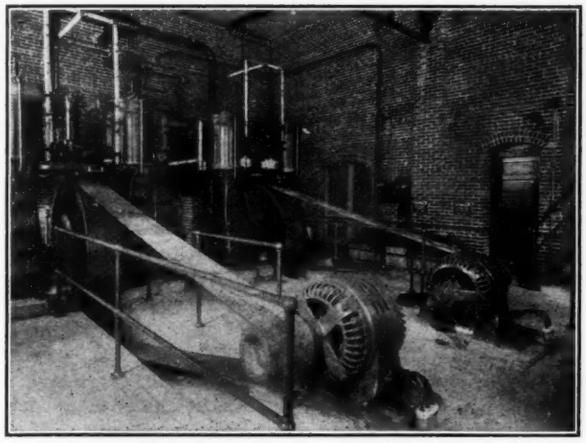


DIAGRAM *showing typical load curves for a central lighting station and an ice plant for the year. The daily operation of the ice plant can be so timed, and usually is so timed from the fact that it is operated mainly during the daylight hours, that the curve marked "combined," which is the load curve of a typical electric light and ice plant for the year, can be approximated very closely at all hours. This means reduced charges for interest and depreciation on machinery required only for the few hours of excessive load usual in small lighting plants.*



COMPRESSING AND CONDENSING *machinery for ammonia. Two motors in foreground of different design to suit requirements made of them. Compressors and condensers in rear against the wall at the left.*

flowing thru the condenser is thus so regulated that it leaves at a constant temperature. This not only produces a very great saving of water, but also maintains a constant head pressure without regard to the load on the compressors or changes in temperature or pressure of the water supply.

The ammonia receiving tank is placed directly below the condensers, thus occupying no additional floor space.

Freezing and Storage.—The freezing tank is 41 feet 3 inches long, 27 feet 3 inches wide and 63 inches high. The expansion coils consist of 8,500 feet of 1¼-inch pipe, fitted with accumulator, and are operated flooded—that is, the liquid ammonia is admitted to the bottom pipe of each coil, so that the coils are always partially filled with liquid. The cold gas, and any unevaporated ammonia leaving the coils, enters the accumulator, where it surrounds a pipe coil carrying the liquid ammonia to the expansion coils, and cools it.

The tank is divided into three sections by bulkheads, and equipped with two vertical agitators. Each of these is direct connected to a 5-h.p. motor.

Fig. 3 is a view showing the tank room, accumulator and agitators. The ironclad starting switches for both agitators are seen on the wall at the left and also the switch for the circuit supplying the crane trolley wires.

The tank contains 374 four-hundred pound cans, fitted for the manufacture of raw water ice—that is, of ice from undistilled water. The treatment of the water up to the point where it enters the cans will be described later in connection with the water supply.

The only difference between the manufacture of ice from distilled and undistilled, or, as it is commonly called, raw water, is that the latter contains air and small amounts of solid mater in the form of salts, such as the sulphates and carbonates of lime and magnesia, which must be removed in order to produce clear ice. The air is removed by agitating the water while it is freezing. The solid matter is expelled from the water as it freezes, until a core of highly saturated water is left at the center of the cake. This core water is removed and the space refilled with fresh water, before the cake is finally frozen solid.

The cans are filled with standard automatic can-fillers, the water being cooled to about 40 degrees in a cooling tank before it comes to the fillers.

In this plant the agitation for removing the air is produced by compressed air. A Connersville blower direct geared to a 5-h.p. motor furnishes the air supply. The air is used at a pressure of 2¼ pounds. The motor shows a load of about 4 h.p. The air from the blower passes thru a pipe coil in the cold water tank, which will be described later. This coil cools the air and condenses out a large part of the moisture. From the cooling coils it passes to headers, placed along each side of the tank and then thru lateral pipes placed between each two rows of cans. From these laterals rubber hose connections are used to the drop pipes in the cans. The air bubbling up thru the water produces sufficient agitation to free the minute particles of air, which are expelled from the water by the freezing and which tend to collect on the surface of the ice. If these particles are allowed to remain they are frozen into the ice and produce a white cake.

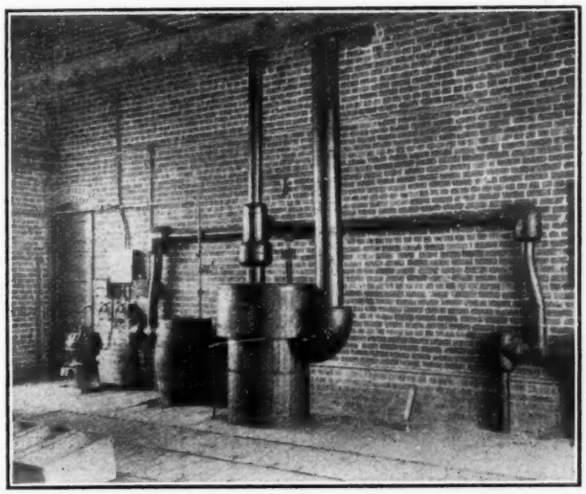
The air agitation is continued until the cake is frozen except for a space about two inches wide thru the center. The air pipe is then removed. The water which is left in this space, called the core, contains all the solid matter which was contained in all the water in the can. This water is removed, the core is refilled with fresh water, and then the cake is left to freeze solid without agitation.

The pump for withdrawing the water from the core is a double acting horizontal vacuum pump direct geared to a 1-h.p. motor. On the wall directly behind the pump is the automatic vacuum controller. The suction of the pump is connected to a tank located in the pump room. The automatic controller is connected to this tank and starts and stops the motor as is necessary to maintain a vacuum of 10 inches in the tank. From this tank a pipe runs to the core suction head. The vacuum in the tank is thus available at all times to withdraw the core water, as the suction line valve is opened.

This tank was designed for freezing in 60 hours, requiring a brine temperature of 17 degrees.

After the ice is frozen, the cans are pulled from the tank by an electric hoist mounted on a traveling crane and placed

FREEZING TANK ROOM *of electric ice plant. Cans in which the ice is frozen are seen in the lower left-hand corner. When in use they are under the covers in the floor, of which parts of three rows are seen in the foreground. The blower, the small electrically driven pump at the left, near the door, and the automatic vacuum controller on the wall behind it are used for agitating the water in the tanks to remove air, and to remove the water from the core of each ice cake, as described in the text.*



in the "thawing dumps." Water which has been warmed by passing thru the ammonia condenser is piped to these dumps, where it is sprayed on the outside of the cans until the cake is thawed loose. The cake then slides from the cans and enters the daily storage room thru automatic doors which are opened by the weight of the ice cake. Ice which is to be delivered during the day remains in this room, which is kept below freezing by ammonia expansion coils placed about the walls. Any excess of ice manufactured over that required for the day is taken into the main storage room, which has a capacity of 225 tons, and is kept at a temperature of about 28 degrees.

Water Supply.—The water supply for this plant is obtained from a 6-inch well, 308 feet deep—about 200 feet of this being in rock. The temperature is practically constant summer and winter, at 53 degrees. The pump on this well has a capacity of 110 gallons per minute, and is driven by a 5-h.p. motor. The discharge line is connected to a 10,000-gallon tank located in the top of the tower. A float switch in this tank stops and starts the pump motor thru a main line solenoid switch, shown on the wall.

The water, as it comes from the well, is used for the ammonia condensers, compressor jackets and general purposes. All water used for making ice is softened and filtered thru sand. Two water-treating tanks are used alternately, treated water for the filter being drawn from one while treatment and settling are taking place in the other.

Each tank is fitted with a float switch connected thru a three-point snap switch with the solenoid valve, so that this valve can be controlled by either one or the other of the float switches. After water has been admitted to one of the tanks by opening a hand valve and turning a switch, so that the solenoid valve is controlled by the float switch of the same tank, no further attention need be paid to the filling, as, when the water has reached the proper height, it is automatically shut off by the action of the float switch and the solenoid valve.

The tanks are also fitted with agitating paddles and only one agitator can be operated at a time. The motor is controlled by a time switch which is arranged to open thirty minutes from the time it is closed. As soon as water is admitted to a tank the clutch lever is thrown to connect the agitator of this tank to the motor, and the motor started. After operating thirty minutes it is automatically stopped.

The proper quantity of lime and soda ash for treating a tank of water are mixed in a tank and pumped into the treating tank. This tank then requires no further attention until it is desired to use the treated water from it, which, in the ordinary operation of the plant, is twelve hours.

During this time treated water is being drawn from the other tank thru a floating pipe arranged so that water is always drawn from near the surface.

The filter is a galvanized iron tank with a layer of 3-inch drain tile in the bottom. This tile supports a perforated plate, on top of which is a total of 30 inches of gravel and sand. A discharge pipe from the bottom of the tank enters the treated water cister thru a float valve, which closes whenever the cister is full, so that the operation of the filter is entirely automatic. The distributing trough has a sewer connection, and a pressure connection is made to the bottom of the filter so that water may be forced upward thru the sand for cleaning, the overflow into the distributing trough going to the sewer.

A float switch is placed on top of the filter, and connected to a red light in the compressor room. Whenever the tank from which the water is being drawn is empty, so that the water level falls to the sand in the filter, this switch closes and lights the red lamp, as a signal to change over to the other tank.

The treated water is taken from the cistern by a pump and discharged to a cooling tank located above the daily storage room. This pump is fitted with double suction and discharge connections and is used both for this service and for pumping the treating solution, the latter service only requiring five minutes every twelve hours. This pump is a 3¾ by 5 horizontal type, geared to a 1-h.p. motor. It is controlled by two float switches and a double-throw hand switch.

The cooling tank is 12 by 5 by 5½ feet. It contains an ammonia expansion coil for cooling the water to about 40 degrees.

All of the lighting in the plant is by tungsten lamps placed close to the ceiling without drop cords. The compressor room was figured on a basis of 2½-foot candles and the illumination is entirely adequate without the use of any drop lights about the machines.

The importance of "uniform" illumination in contrast with the too common "bright spots" illumination in a plant operating 24 hours per day can hardly be overstated. It not only means comfort to the operators, but better care of the machinery and more output.

As this plant was not completed until the middle of last August, there has been very little opportunity for full load operation. However, from the data obtained for the short time that it was operated at approximately full load, it is evident that this plant will produce a ton of ice, including the pumping of all water, the operation of all auxiliaries and the refrigeration of both storage rooms on less than 40 kw. hours.

Terms of California Water Works Franchises

Under Const., Art. 11, Sec. 19, providing that in any city having no public works to supply water, any individual or company shall have the privilege of using the streets for laying conduits as necessary to supply the city and its inhabitants with water for domestic and all other purposes, on condition that the city shall have the right to regulate the charges thereof, a franchise, granting the right to an individual who was the highest bidder to use the streets of a city for the distribution of water to its inhabitants on condition that he and his assigns pay to the city 7⅞ per cent. of the gross earnings arising therefrom, as authorized by St. 1897, p. 135, was unconstitutional in so far as it provided for such payment, and therefore unenforceable, though it also provided that it should not be construed as granting an exclusive franchise. Neither the municipality nor the legislature could grant an exclusive franchise for that purpose.—Town of St. Helena (Cal.) v. Ewer et al., 146 Pac., 191.

Private Claims to New York City's Water Supply Sources Groundless

The groundlessness of the claim that the provisions of N. Y. Laws 1895, Chap. 985, empowering a water company to acquire title to land and water for its corporate purposes in the manner specified by the general railroad act (Laws 1850, Chap. 140), gave such company, as the result of filing a map without notice to landowners or other preliminaries, a vested right to exclude the rest of the world from a drainage area or watershed covering a thousand square miles, is so obvious as to require the dismissal for lack of jurisdiction of a suit in a Federal District Court to enjoin municipal interference with such alleged right on the ground that due process of law is denied and contract obligations impaired by the laws under which the municipality is acting.—Ramapo Water Co. v. City of New York et al., 35 Sup. Ct., 442.

The New Water Filtration Plant at Quincy, Ill.

By W. R. Gelston, Superintendent, Quincy, Illinois.

The author describes in this paper, which was read before the Illinois Section of the American Water Works Association, the new reinforced concrete plant for treating Mississippi River water for use by the citizens of Quincy. It is a modern water-purification plant in every sense and replaces one of the oldest mechanical filter plants in the country, which was installed in 1891 and operated until September 1, 1914, when the new plant went into operation. It is a good model for the smaller cities which obtain water from surface sources requiring sedimentation and filtration.

ON the first day of September, 1914, one of the oldest mechanical filter plants in the United States was abandoned and a complete modern purification system was placed in operation at Quincy, Ill., to take its place.

The old plant was built about the year 1891 under the O. H. Jewell patents and consisted of a stone masonry sedimentation basin 70 feet by 70 feet in area and 9 feet deep and 14 wooden tank filters 12 feet in diameter. There was also a small clear well under the filter tanks. This plant provided a sedimentation period of about one hour and the capacity of the filters was about 4,000,000 gallons per day under the usual rating for mechanical filters.

The new plant is of reinforced concrete with brick superstructure, steel doors and windows, and it is absolutely fireproof. Three thousand cubic yards of solid rock were excavated to prepare the site for the foundation and the entire plant rests upon solid rock. The east wall is also backed up by a solid limestone ledge which rises from 12 to 15 feet above the basin floors.

The concrete structure is 172 feet by 89 feet and the highest concrete walls rise 25 feet above the footings. Of the total area, the six 1,000,000-gallon filter units, with the pipe gallery, cover 40 feet by 89 feet at the north end. Adjoining the filters on the south, a space 12 feet by 89 feet is used for the main entrance and stairways leading down to the pipe gallery and up to the operating floor, and for the steam heating plant and coal bin. Then a space 24 feet by 89 feet is occupied by the forebays and mixing chambers. The remaining area, 96 feet by 89 feet, is used for sedimentation purposes.

Two complete coagulating, mixing and sedimentation units are provided and connected in such a manner that they can be operated in parallel, in series, or either unit may be operated alone. They are of unequal capacity. The No. 1 unit provides for two-thirds of the total capacity and the No. 2 unit one-third.

Our short experience with this plant leads us to believe that the best results can be obtained by the series method of operating. The plant is therefore being operated as follows:

The low service pumps discharge into an open forebay where the water is treated with the first dose of sulphate of alumina. It then travels about 400 feet over and under the concrete baffles in the mixing chambers and finally passes thru sluice gates into sedimentation basin No. 2. This basin is 27 feet by 94 feet by 20 feet in depth and is provided with a vertical concrete baffle which extends nearly the entire length of the basin on the center line. When the plant is operating at a 6,000,000-gallon rate this basin provides a travel of about 175 feet and a period of one and one-half hours for sedimentation. From the outlet side of this basin the water is drawn from the surface, over a weir, thru a large sluice gate, and passes thru a concrete flume to the second forebay, where it receives its second dose of alum, as it begins its tortuous passage thru the mixing chambers connected with basin No. 1. This basin is 55 feet by 94 feet by 20 feet deep with one vertical concrete baffle on the center line around which the water must pass. The sedimentation period in this basin is about three hours, making the total for both basins four and one-half hours. The water passes from the outlet side of this basin to the filters.

Steel storage tanks for coagulating solutions are provided in duplicate for the alum and lime. A small electric motor is used to stir the solutions constantly to keep them of uniform strength.

The coagulant feed is accomplished by means of constant-head orifice boxes, the solution flowing by gravity from the orifice boxes to the forebays.

A complete hypochlorite sterilizing plant is also installed in duplicate. This solution flows by gravity and it is introduced into the filtered water as it passes thru a 24-inch pipe line on its way to the high-service pumps.

The six filters are grouped three on each side of the pipe gallery. They have a sand area 12 feet by 32 feet and they are 10 feet deep. The regulation New York Continental Jewell Filtration Company strainer system, as designed for the combined air and water wash, is used. The strainers are covered to a depth of one foot with graded gravel and the sand has a depth of 30 inches. Ottawa sand of .38 of a millimeter effective size is used. Two steel wash-water troughs run the entire length of the filters and provide a very uniform flow of water from the entire sand area during the washing process.

The filters are equipped with loss of head gages, hydraulic-operated valves and the simplex Venturi tube type of rate controllers. The space under the filter beds is used for storage of filtered water. The two basins, 32 feet by 38 feet each in area and holding a depth of water of 9 feet, provide storage capacity for 160,000 gallons. Since water for filter washing is taken from the clear wells the capacity is rather small and it would be entirely inadequate if direct pressure were maintained. Duplicate motor-driven centrifugal pumps and one motor-driven blower comprise the necessary mechanical equipment for filter washing.

The brick superstructure is of handsome design. A buff-colored St. Louis hydraulic pressed brick with a dark red brick for quoins and Bedford stone trim comprise an exterior of pleasing as well as substantial appearance.

The head house, which is 62 feet by 89 feet and two stories in height, is located over the forebays, mixing chambers, and a part of the sedimentation basins. The second floor is of reinforced concrete supported by concrete columns and beams. This floor provides ample space for the storage and mixing of coagulants. The tops of the solution tanks extend 3 feet above the second floor and they rest upon concrete platforms which stand 5 feet above the lower floor. Numerous manhole frames and covers, set in the floor, provide access for cleaning and opportunity for study of the effect of the coagulants on the water as it passes thru the mixing chambers. Large rect-

angular openings over the inlet and outlet of the sedimentation basins also provide convenient points for sampling and observation of the operating results.

A well-equipped water-works laboratory is also located on this floor. It consists of four connecting rooms having a total floor area of 625 square feet, with well-lighted work benches and sinks, and all of the apparatus and utensils necessary for the preparation of media and for the bacterial and microscopic examination of water.

The filters are covered by a one-story brick superstructure which rests upon the outside walls of the filters, leaving the entire area of the filter beds open for inspection. This room is well lighted by means of a monitor roof over the operating floor in addition to the windows in the side walls.

The original designs for this plant were prepared by Messrs. D. W. Mead and C. V. Seastone, consulting engineers, of Madison, Wis. The contract for the construction of the plant was awarded to the New York Continental Jewell Filtration Company, and this company sub-let the building construction to the Coddington Engineering Company, of Milwaukee, Wis. Mr. Carl Francis was resident engineer for the filter company during the construction period, and Mr. Gilbert H. Pratt was in charge of its operation during the official efficiency test which was conducted by Mr. W. F. Langelier of our State Water Survey. Valuable assistance was also rendered by Dr. Bartow and Mr. Paul Hansen, in the preparation of the plans and the final award of the contract.

ADVERTISING A CITY BY MOVING PICTURES

By Albert Marple, Tropico, Cal.

THERE are many cities in this country which have established municipal utilities and departments of various kinds, but it remained for Redlands, Cal., to adopt a motion picture department as a regular feature of the city. This motion picture department was originally organized and is now being maintained for the specific purpose of advertising that city.

Something like a year ago there was a certain road several hundred yards in length, lying a mile or so north of Redlands, that was in very poor condition. It was a road that was used by most of the business men of the city, and for that reason all of the merchants were affected by its poor shape. A day was set for a general clean-up and repair of that particular branch of road, and on the morning of that day practically every business man of Redlands was on hand with his pick and shovel, and in the single day the roadway was repaired. Prior to that day the members of the Chamber of Commerce of that city thought it would be a good plan to have a motion picture machine on hand to catch these merchants at work, and, simply as an advertising "stunt," to send the pictures around the country. This was done, the pictures were taken, the films first being shown in Redlands, then sent to other cities and towns along the Pacific coast.

Well, the advertising received from that string of pictures, which constituted a complete reel, was so widespread and valuable that the Chamber of Commerce decided to make this motion picture department a permanent feature of its work. There are no particular things about the city that are especially photographed. Many of the various industries of that section have been taken. For instance, the orange industry, which is the largest business of that section, has been photographed from start to finish. From the planting of the orange trees, picking, etc., to the packing and shipping of the fruit—everything has been shown, several reels, each consisting of about 1,000 feet, being required for this work. Then there are the special gala days that are held in the city, street dances, etc. As these things occur they are photographed, immediately finished and sent around the circuits.

The outfit necessary for the equipment of a department of this nature is not so very expensive. The motion picture machine owned by this city, the developing and finishing outfit, etc., cost something like $325. Redlands is fortunate in having one of their home men do their photographing for them. This man is an expert with the motion picture machine, and, in fact, knows the "movie" game from start to finish. Every reel of film that is taken by this "home talent" man costs the Chamber of Commerce about $150, while it is estimated that if an outside camera man were employed the expense would be between $500 and $600 per reel. At present the Chamber of Commerce pays for only the actual cost of the film, finishing, etc. The operator donates his time, or, rather, gives his time in exchange for the use of the camera at any time that it is not being used on some of the work of the municipality. It is safe to say that under ordinary circumstances a reel of pictures would cost the ordinary city, should they find a home man that could do the work, in the neighborhood of $250. Redlands is located close to the motion picture centers and everything is handy.

Now, as to the method of exhibiting these films. Immediately after being finished the pictures are shown in the local theaters. After this has taken place they are sent to the headquarters of the nearest motion picture circuit, and for weeks, sometimes months, they go from one motion picture house to another in that circuit, or until all of the houses have exhibited the pictures. After this circuit has been "worked" the outside circuits are given the opportunity of handling the pictures. A feature of this business is that the pictures are loaned to the various theaters without any expense to the managements of the various play houses, and it might be said that these managers are more than willing to run the films, for in many instances they take the place of a string of pictures which the proprietor would otherwise have to pay for. If the show's regular program is not cut down, the pictures prove a "Special Attraction." Pictures like the orange industry and others of a similar nature are intensely interesting and instructive. As to how long the pictures may be kept running, it might be stated that this picture of the orange industry has been going the rounds of the various circuits for almost a year. During that time it has been seen by hundreds of thousands of theater-goers, who have been informed that Redlands is on the map and the principal business of that section is the orange industry. The city and the city's business are linked together in the minds of all these people, and consequently, when these people think of oranges, they instinctively think of Redlands. The value of this advertising may at once be seen. The value of the news pictures, such as the street dances, etc., is not so long-lived, however, for no one cares to hear or see news events that happened a year before.

The boosters of Redlands believe that this is by far the most valuable kind of advertising for which they pay out their dollars.

QUESTION DEPARTMENT

Statistics of Street Pavements

I would like, if possible, to get some statistics in reference to the total amount of pavements of different kinds laid in the United States in 1913 and 1914 and what the prospects are for 1915. S., Bogalusa, La.

The only official statistics of this sort are those of the United States Census Bureau, which are supposed to be collected every two or three years for cities of more than 30,000 population. Unfortunately the department has not been able to prepare the returns for publication rapidly and the latest volume is of the statistics for 1909 which were prepared for publication in 1913 and not actually published until 1914.

The April number of MUNICIPAL ENGINEERING contained estimates of the prospective work for 1915 in a large number of cities, but is not complete, as many cities, this year in particular, have not yet decided what they will do this season. Several journals publish annual tables of work done during the previous year, but are not any more complete than the tables of prospective work, and, except in a very few cases of single cities, can not be used for comparative purposes and do not give any adequate idea of the total amount of work done in all the cities of the country.

Possibly if enough pressure were brought to bear upon the Census Bureau it could be induced to bring its publications on the statistics of cities nearer up to date. The latest volume of "Financial Statistics of Cities" is for 1912, but the latest volume of "General Statistics of Cities" is for 1909.

Use of Asphaltic Macadam and Asphaltic Concrete for Pavements

Have you any information that you could give us with regard to the use of various materials for pavements? What is chiefly used? Are asphaltic concrete and macadam used very extensively? Have you any data as to manufacturers making equipment for mixing these materials? In your opinion, would you consider this field a very big one for the sale of mixing equipment? Any data or information that you have on this subject will be greatly appreciated.

N., ———, Wis.

The best source of information on the amounts of various kinds of pavement in use in cities is the U. S. Census report, giving general statistics of cities of 30,000 population or more. The report is five years or more behind in publication, but is the only complete report. Bituminous macadam and bituminous concrete, as those terms are now understood, are comparatively recent additions to the list of pavements, tho bitulithic, which is the standard of quality for pavements made of stone and asphalt, is very largely used and has been for some fifteen years.

For country roads the bituminous pavements of the cheaper qualities have been developed, especially near the east coast, in the far west, and where the freight rates on the materials are not excessive.

The probable use of these pavements on both city pavements and country roads is shown in the tables of work in prospect for 1915, which were published in the April number of MUNICIPAL ENGINEERING. The columns headed "Asphalt Concrete," "Asphalt Macadam," "Bitulithic," "Bituminous Concrete" and "Bituminous Macadam," together show all the varieties of such pavements which are in prospect for this year.

A number of manufacturers produce mixers for this work of various kinds. Road plants have been devised, such as the Hetherington and Berner plants described in the April number, the F. D. Cummer & Son Company's plant, and the East Iron and Machine Company's plant, all three advertised in the same number. All three of these manufacturers and also Warren Brothers Company and the C. B. Smith Company make stationary plants for mixing all kinds of asphaltic and bituminous pavements, also such plants mounted on railroad cars. The Link Belt Company may also be added to this list.

Some manufacturers of concrete mixers have added methods of heating the mixers, so as to make them available for mixing asphaltic macadam materials and one or two such small mixers have been designed expressly as hot mixers. The Koehring mixer of this class is advertised in the April number, also.

Garbage Reduced to Fertilizer

In the July, 1914, issue of MUNICIPAL ENGINEERING appeared an article on garbage disposal, describing a method used in England whereby the refuse is converted into a marketable fertilizer.

Being interested in the matter, I wonder if it would be possible thru your means to get in touch with some person or manufacturer who might furnish me with detailed information regarding said practice, as well as to the machinery employed.

Whatever aid you may lend me, I will greatly appreciate, and thanking you in advance, I beg to remain,

Yours very truly,

L. E., San Juan, Porto Rico.

This seems to be a plant similar to a French plant quite fully described in MUNICIPAL ENGINEERING for July, 1913, vol. xlv, p. 25. E. B. Stuart, 36 S. Ashland Boulevard, Chicago, Ill., is the representative in this country of the French patentees.

An article in this number of MUNICIPAL ENGINEERING describes a new method now under trial of pulverizing garbage and refuse and turning them into fuel briquets.

The Hirsh chemical system, described in vol. xlvii, p. 131, August, 1914, may also be of interest in this connection.

WORKERS IN THE FIELD

Cost of Asphalt Repairs in Pittsburg

The Editor of MUNICIPAL ENGINEERING:

Sir—That the best previous record in the patching and resurfacing of asphalt streets in Pittsburg was far outstripped during 1914 is revealed in the annual report of James D. Strain, superintendent of the two municipal asphalt plants, to John F. O'Toole, superintendent of the Bureau of Highways and Sewers, and Director Robert Swan, of the Department of Public Works. The number of square yards of asphalt laid in 1914 exceeded by 41 per cent. the amount laid in 1913, which was the highest record up to that time.

Last year 418,723.6 square yards of asphalt were laid by the municipal plants. The record in 1913 was 296,715.65 square yards, and in 1912 the total was 229,462.60 square yards. The figures do not include, of course, the asphalt laid in connection with the complete paving or repaving of streets, that work having been done entirely by contract.

Superintendent Strain said that he has no figures on which to make a complete comparison with other cities, but expressed himself as doubting that any municipal plant in the county did more work last year than the Pittsburg plants. The new Pittsburg plant, on the north side, known as No. 2 plant, was in operation during only three months of the paving season last year.

Not only in the quantity of work performed, but also in the matter of cost, the great worth of the municipal plant to the city has been demonstrated.

The total cost of asphalt laid by Plant No. 1 in Pittsburg last year was $0.8672 per square yard, and for that laid by Plant No. 2 the cost was $0.898 per square yard. The overhead and general charges for both plants are figured into the cost per square yard.

No patching or resurfacing work has been done by contract for a number of years. The cheapest contract ever given by the city for resurfacing work was awarded about nine years ago, and the contractor received $1.25 per square yard for the asphalt laid.

The cost for No. 2 plant was somewhat higher than for No. 1, because considerable time is required after a new plant is placed in operation to bring it to its greatest efficiency. The overhead and general charges for No. 1 plant last year amounted to $0.1455 per square yard of asphalt laid, and for No. 2 the same charges totaled $0.0846 per square yard. The difference is largely represented by the fact that all the road equipment is charged to Plant No. 1, and a valuable property is owned by No. 1 plant, for which a charge of interest at the rate of 6 per cent. is made in the accounts. No. 2 plant is on leased ground, the rental being $1,500 a year.

The showing as to the cost is all the more gratifying to the city officials, because the labor cost to the city is considerably higher than the contractors. The city paid its laborers last year 25 cents an hour, and the average wage paid by contractors was 17½ cents an hour. The city paid rakers $2.50 for eight hours, and contractors paid $2.75 for ten hours. Tampers received $2.25 from the city for eight hours, as against $2.00 paid by contractors for ten hours.

Much of the work done by the plants is patch work, and all pavers recognize this as being much more tedious and costly per square yard than resurfacing work. Of the 418,723.6 square yards of asphalt laid by the city asphalt plants last year, 142,815.65 yards represented patch work. The plants also found, in a few instances, that it was necessary to rebuild some foundations in streets before resurfacing. In doing this, 2,161.6 cubic yards of concrete were laid at a cost of $9,764.78. The resetting of curbs cost $1,681.78. Both the concrete and curb setting costs are charges against the plants and are reflected in the unit cost given for the patching and resurfacing.

JOHN B. TOWNLEY,
Superintendent Bureau of Publicity,
Pittsburg, Pa.

Closed, Open or Alternate Paving Specifications?

The Editor of MUNICIPAL ENGINEERING:

Sir—What would happen to a business concern or an individual who adopted a policy of buying only the cheapest materials offered? The answer to the question is obvious, so obvious that the query seems foolish. And yet municipalities in a good many instances are adopting a policy which results in shutting off the possibility of getting any but the cheapest supplies if the rule (or the law, as it is in many cases) as to acceptance of the lowest bid is followed. This policy is the result of a laudable endeavor to increase competition and remove opportunity for graft and favoritism of the kind that has cost cities a good many dollars in the past. But these two aims can better be achieved than by means of "wide-open" specifications, which admit almost anything and which (when accompanied by the low-bid rule) result in the purchase of cheap instead of good materials.

Suppose that a dozen office tables were wanted and the specifications on which bids were asked provide only that the tables must be of wood, with tops 4x6 feet. It would be known in advance that the buyer, if he accepted the lowest bid, would not get mahogany or oak or even pine tables. He would get only the cheapest and poorest tables. Competition is not increased; good tables are barred out. The only bidder who has any chance is the one who intends to furnish the poorest tables on the market.

Wide-open asphalt paving specifications work out in exactly the same way.

Under such a specification it is attempted to make one

description fit a variety of products which differ chemically, physically, intrinsically and in cost, market value and price. To do this it is necessary to make the limits of the description so wide that it will include almost everything. Some specifications of this kind do, in fact, cover products as different in cost and character as natural lake bitumens, fluxed gilsonite and residual asphalts made from petroleum, and in the latter class include blown products. In other words, there is no discrimination as to classes of asphalts nor as to the products belonging to various classes.

This is done in the name of competition. But what is the result? Competition is not increased; it is destroyed. There can be no competition between mahogany tables and cheap pine tables, nor is there any competition on a price basis between the asphalt that costs most and that which sells for the lowest price. Under the wide-open specifications, where the lowest bid must be accepted, instead of competition a monopoly is created, a monopoly for the cheapest and presumably the most inferior goods or workmanship or both.

The alternate specification provides a means of avoiding the absurdity of the state of things just described, and at the same time increase competition, not in word but in fact. What is just as important, the alternate specification leaves the authorities of a city free to get exactly what is wanted; to discriminate in their purchases as between what is good and what is merely cheap. Under the alternate form of asphalt specification there may be described all classes of asphalt; each is in the specifications on exactly the same terms as the others, and separate bids are called for on the different classes of materials. The city can then award the work to the lowest bidder in any class. If it is considered that the lowest bid contemplating the use of the cheapest asphalt is the best bid, it can be accepted; or, on the other hand, if the conditions warrant the acceptance of the lowest bid for the highest class of materials, that may be done. The city has not restricted itself; it has enlarged its freedom of choice. Competition has not been limited; it has been enlarged.

The enactment of equal-price laws is extending yearly. But ahead of this tendency is the establishment of uniform prices for staple products of high reputation. It is only the refuse of trade that is sold for "what it will bring." This makes it safe enough for a city to close its specifications with a feeling of perfect security that it will not be held up for a higher price than is paid under competitive conditions. But the prejudice or objection to closed specifications is, nevertheless, likely to control, except where there are officials who know exactly what they want and do not hestitate to say so, in spite of any clamor that their stand may create. In view of this the recourse to alternate specifications is a necessity if officials are to have full opportunity to buy most economically (which does not mean buying the cheapest materials) for municipalities. This, of course, applies to many products besides asphalt.

Indianapolis and Washington, D. C., among many other municipalities, have operated under alternate paving specifications for years and have found this policy a paying one from every viewpoint. The logic of the situation is producing many converts to the adoption of a similar policy, and it may be expected to spread year by year in spite of effort on the one hand to close specifications, or on the other hand to open them so widely as to confer a premium on cheapness without regard to quality or worth.

DANIEL T. PIERCE,
Philadelphia, Pa.

El Oso Asphalt

The Editor of MUNICIPAL ENGINEERING:

Sir—El Oso Asphalt is a trade name used by the late F. O. Blake, with offices at St. Louis. Mr. Blake owned a refinery in or near Los Angeles. El Oso asphalt was used in two or three pieces of work at Little Rock, and has been used quite extensively, I understand, by the Kaw Paving Company, of Topeka, Kans. It is the same quality of material that is gotten out by the Union Oil Company and other California asphalt concerns. The writer has found no difference between El Oso brand of California asphalt and other brands of the same material. The El Oso Asphalt Company have offices at Los Angeles and operate their refinery at that point, under the management of two of the Blake boys, who were in business with their father.

A SUBSCRIBER.

Refuse Collection in River Forest, Ill.

General Manager Karl M. Mitchell, of River Forest, Ill., prints in the local weekly paper the following information for and instructions to citizens, showing how to aid in making the collection of garbage as sanitary and economical as possible:

The winter schedule for the collection of ashes and garbage is as follows:

Monday—North of the Northwestern railway, Harlem to Lathrop.

Tuesday—North of the Northwestern railway, Ashland to Park.

Wednesday—North of the Northwestern, Forest to Keystone.

Thursday—North of the Northwestern, Thatcher to Edgewood.

Friday—South of the Northwestern railway, Thatcher to Forest.

Saturday—South of the Northwestern railway, Park to Lathrop.

During the cold weather it is important that garbage be thoroly drained of water and wrapped in paper before placed in the can. Ashes should not be wet during the winter. The contractor cannot be expected to remove frozen contents from cans, whether garbage or ashes, nor be responsible for injury to cans resulting from this practice.

Clean-Up Week in Philadelphia

Mayor Blankenburg, of Philadelphia, Pa., designated the week of May 3 to 8 as the time for all citizens to clean up within and without their premises. It is the third annual "Clean-up Week for a Spick and Span Philadelphia."

To make a "spick and span city" of such a great metropolis as Philadelphia would seem a tremendous task. But the administration declares it to be simple. As to cost, less than $20,000 will do the whole work.

The essential factor is that every householder, every property owner, every business man, shall see to it that during "clean-up week" he turns over to the city rubbish-collection contractors everything in and about his premises that he does not want, and which is occupying space he could use, and, at the same time, insure better sanitary conditions, both for himself and his neighbors.

Such riddance of rubbish last year amounted to 140,000 cubic yards, and this accumulated waste and rubbish was carted away to reclamation stations and dumped at a total cost to the city of $17,087.44. It would have covered an ordinary city block, 300 feet square, to a depth of 42 feet.

The gross cost to the city for the collection and disposal of the rubbish was only slightly more than 12 cents a cubic yard.

On the basis of population the assessment would have been 1 1/10 cents per inhabitant, or a contribution, possibly, of less than 5 cents per family.

LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

EXEMPTION FROM TAXATION AS COMPENSATION FOR WATER FURNISHED CITY.

No legislative authority being shown authorizing the boro to make a contract exempting the property of the water company from taxation, such a contract is not valid, but if in form the contract is one to exempt from taxation, and is really one to pay for water supplied to the boro for its municipal purposes, a sum equal to the amount assessed for municipal taxes, such a contract is valid.—Montclair Water Co. v. Montclair, 81 N. J. Law, 573; 79 Atl., 258.

The covenant to furnish water and the covenant to exempt from taxation are independent, and there is no connection between the amount of tax to be released and the value of the water to be supplied. Section 4 of the ordinance, and also of the contract, provides that the water shall be furnished free of charge. If the prosecutors are right, the water would not be furnished free of charge, but would be paid for, and at a price apparently in excess of the ordinary charge. The consideration for the agreement to furnish the water free of charge seems to have been the consent of the municipality to the incorporation of the water company.

The fact that for years after the contract was made the water company did not claim any exemption is of some significance as a contemporary construction.

The tax is affirmed, with costs.—Point Pleasant Water Works Co. v. Mayor and Council of Boro of Point Pleasant Beach (N. J.) et al., 93 Atl., 94.

PROCEEDINGS FOR CITY TO ACQUIRE PRIVATE WATER WORKS PLANT.

In mandamus by a municipality to enforce its right to inspect the records and plant of a water company as a step in the acquisition of the plant pursuant to act of April 29, 1874 (P. L. 73), the owner of the water works is the proper party defendant, and the lessee of such works, though operating same, is improperly joined where the lessor and lessee have not been merged by the terms of the lease and the former maintains its corporate existence and a supervision over the business and shares in the net receipts, as to which the lessee is required to render an accounting.

Proceedings by a municipality for the acquisition of water works, if instituted since Utilities Act, July 26, 1913 (P. L. 1374), are invalid, unless they have been previously sanctioned by the Public Service Commission.—Boro of New Brighton (Pa.) v. New Brighton Water Co. et al., 93 Atl., 327.

Act May 31, 1907 (P. L. 355), providing a method of determining the price which a municipality may pay for a water company's plant, not being inconsistent with Act April 29, 1874 (P. L. 95), Sec. 34, Cl. 7, providing a procedure by which a municipality may compel a conveyance to itself of a privately owned water plant within its boundaries, does not repeal the earlier statute.

Mandamus will issue at the instance of a municipality which has elected to take over a water company's plant under Act April 29, 1874 (P. L. 73), to compel the company to allow access to its books and papers that information may be secured as to the value of the plant.

Act July 26, 1913 (P. L. 1386), Art. 3, requiring the approval of the Public Service Commission to a municipality's acquisition of a water company's plant, does not effect a mere change of procedure, but qualifies the former rights of municipalities to take over the property of water companies within their limits, and hence, in the absence of an express provision, is not retroactive, so as to require the approval of the commission to proceedings pending when the act became effective.—Burgess, etc., Boro of Reynoldsville (Pa.), v. Reynoldsville Water Co., 92 Atl., 1082.

CONSTITUTIONAL LIMITATIONS OF HOME-RULE CITY CHARTERS.

The rule requiring statutes to be so construed as not to infringe constitutional inhibitions, if reasonably susceptible of such construction, applies to so-called home-rule city charters, and the provisions of such charters are not to be held void if they can reasonably be construed so as not to transgress such inhibitions.—State ex rel. Oliver Iron Mining Co. v. City of Ely (Minn.) et al., 151 N. W., 545.

SPECIFICATION OF "AN APPROVED PATTERN" INSUFFICIENT.

Where a city sewer ordinance provided for catch-basins, each provided with a cast iron cover weighing not less than 325 pounds, and of an approved pattern, the words "approved pattern" were meaningless, and the ordinance was therefore invalid, and was not cured by a subsequent ordinance declaring that they should be held to mean a cover of the same form, size, quality and pattern as one then in use at a certain street intersection in such city.—City of North Chicago (Ill.) v. Cummings et al., 107 N. E., 776.

Warren Paving Machinery Patents Sustained

The Texas Asphalt Paving Company is restrained from using paving machinery which is covered by patents held by the Warren Brothers Company, in a decree rendered by Judge Henry D. Clayton at El Paso, Tex. The injunction of the court is entered against John W. Eubank, who represents the defendant company. Suit was entered against the Texas Paving Company several months ago by Warren Bros., who charged the defendants with unlawfully using machinery which belonged only to them by right of patent.

A Comprehensive Clean-Up Campaign for Cincinnati

The Chamber of Commerce of Cincinnati, O., is preparing, thru its civic and industrial department, a campaign for a general cleaning up of the city which is more comprehensive than is possible in the "clean-up week" movement and is intended to be continuous in most of its lines.

C. R. Hebbie, the manager of the department, has thoroly organized the work and put its details into the hands of a number of committees which have numerous meetings separately and in groups as the developments of their work demand. There are eighteen of these committees, whose duties are briefly stated as follows. The organization is one which may be found extremely useful in any city having a public-spirited citizenship.

Speakers.—To provide speakers for meetings of district organizations, welfare associations, civic and other interested bodies. To see that the speakers are provided with "Clean Up and Paint Up" campaign lantern slides where they are desired. These lantern slides will be provided either by the Chamber of Commerce or public library.

Publicity.—To take steps to have the campaign given proper publicity thru the press and otherwise. This may involve the distribution of circulars on various subjects, campaign buttons, window cards and other means of publicity.

Inspection—To arrange, plan for and direct a complete general inspection of the city, beginning at the end of the campaign. To secure co-operation and assistance of citizens and municipal departments, State Fire Prevention Association and state fire marshal. To provide for a reinspection following the general inspection.

District Organization.—To lay the city out in districts and determine upon plans of organization of these districts. To provide instruction and recommendations in accordance with these plans. To have general supervision of district work.

Laws and Ordinances—To provide the executive committee with legal advice and to recommend such changes in city ordinances as may be desirable in the light of the results of this campaign. Where necessary to bring to the attention of city officials violations of laws which are brought to the notice of this committee.

Expenditures.—To authorize and pass upon all expenditures before they are undertaken. To authorize all bills and approve same for payment.

Planting and Sodding.—To supply publicity committee with subject matter for the encouragement of planting vines to cover unsightly structures, the planting of shrubbery and flowers, and the sodding of bare spaces. To give advice as to when, how and what to plant. This advice is to be given to all individuals, local committees, organizations, etc., and perhaps also to be published in the shape of printed circulars for distribution. To secure the co-operation of the park department and encourage increased activity in school garden work.

Vacant Lots—When requested to do so by local organizations render it aid in providing it proper facilities to clean up vacant lots, attend to the removal of unsightly structures, and, when necessary, invoke the assistance of city officials and the committee on laws and ordinances. To examine carefully into the problem of vacant lots and make recommendations to the committee on laws and ordinances as to the solution of the problem.

Fly Extermination.—To devise means for fighting the house fly in every possible way, and supervise the carrying out of such plans.

Sanitation.—To give careful consideration to the general subject of "sanitation" both in the home and the problem of the city. To render every assistance to district organizations on this subject, and after a complete survey of the situation, to make definite recommendations to the committee on laws and ordinances and confer with them to the end that such amendment as may seem desirable may be formulated and secured.

Public Dumps and Waste Disposal.—To give careful consideration to the difficult problem of public dumps and disposal of waste to the end that the number of these dumps may be reduced and that ultimately their use may be discarded. To work out some scheme for disposal and incineration of the city's waste, and to stimulate public sentiment toward such action on their part as will make possible the sale of waste paper by the city in order that revenue may be derived therefrom. To encourage upon the part of citizens the burning of all combustive waste in order to lighten the work of the street cleaning department.

Smoke Elimination.—In every way possible to encourage propaganda against the smoke evil. To plan for and secure the co-operation of Cincinnati people in this matter.

Clean Streets, Alley and Sidewalks.—To devise and execute plans to secure the co-operation of citizens of this city in order that our streets, alleys and sidewalks may be kept clean. To make a careful examination of city ordinances affecting this question and to make definite recommendations to the committee on laws and ordinances on this subject and to confer with them in regard to the revision of present laws.

School, Y. M. C. A. and University Organizations.—To devise and execute plans for securing the co-operation of all organizations existing in the public schools and university, and to secure the co-operation of the Y. M. C. A., Boy Scouts and other similar organizations.

Garbage.—To give careful attention to the question of the disposal of the city's garbage. To stimulate compliance with

the law upon that part of citizens, and to assist the city officials in this matter, and to make any desirable recommendations to the committee on laws and ordinances.

Women's Organizations.—To secure the co-operation of all women's clubs and organizations in the city, thru communication of their officers, and by speaking at their meetings.

General Committee.—This committee is composed of all the members of all the committees, and shall act in an advisory capacity to the executive committee.

Executive Committee.—This committee is composed of the members of the Chamber of Commerce committee on continuous clean up and fire prevention campaign, and is in immediate charge of the "Clean-Up and Paint-Up" campaign. The chairman of this committee is general chairman of the campaign and the secretary its general secretary.

Making Fuel Out of Garbage

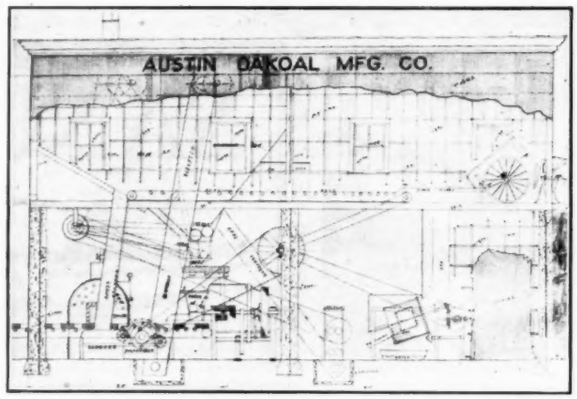
By W. D. Hornaday, Austin, Tex.

Manufacturing a high-grade fuel from garbage is a new industry that promises to solve the problem of disposing of the waste of towns and cities. In October of last year the first experimental plant of the new garbage disposal process was established in San Antonio, Tex. It has proved so successful that a large plant is to be erected in Austin, Tex., by E. L. Culver, who is the inventor of the new process, and his associates. They have entered into a contract with the city by which they receive 25 cents a ton for all the waste, delivered at the plant. This is about 50 cents per ton less than it now costs the city to dispose of its garbage.

The important feature of the new method of handling the trash and waste that comes from the streets and alleys is that it is converted into a fuel that is said to be the equal of bituminous coal. Mr. Culver began investigating the possibility and practicability of commercializing municipal garbage about five years ago. As a result of a long series of experiments he proved the adaptability of a method for making fuel bricks out of the refuse. This is accomplished in much the same manner that stiff-mud bricks are made. He employs practically the same machinery that is used in making mud cut bricks. There is this difference in the process, however: the fuel bricks are not required to be as smooth and perfect as building bricks. The fuel bricks are dried in the sun or open air instead of in kilns. To produce this new fuel from garbage a mixture of equal quantities of coal dust and garbage, with an addition of 7 per cent. of water gas tar from gas plants or oil refineries, is used.

It takes one thousand of the fuel bricks to make a ton. They are clean and dustless and are easy and convenient to handle. In San Antonio the new fuel is being used by many people in their homes. The demand for it is said to be much

FUEL BRIQUETS *made from garbage.*



SECTION OF PLANT *for turning garbage into fuel briquets. Garbage is dumped at upper right-hand, carried on conveyor to chute at left, dumped into the garbage pulverizer, thence elevated to the roll feeder, where it meets coal coming up the coal conveyor from the coal pulverizer, is mixed with coal and tar, and the mixture is dropped to the press for making briquets.*

greater than the supply. Among its advantages are that it will not slack, no matter how long it is kept in storage, that it is impervious to water, and that it burns to ashes without leaving a semblance of clinkers. It produces no odor and little smoke when being burned. Dr. William B. Phillips, of Austin, director of the Bureau of Economic Geology and Technology of the University of Texas, who recently experimented with the fuel bricks by burning a number of them in an open grate at his home, made a report on the results, as follows:

"The briquets had no disagreeable odor whatsoever, smelling faintly of tar; they were easy to handle, cleanly, easy to fire, gave no excess of smoke over ordinary bituminous coal, did not clinker and did not give any trouble at all in the grate. These briquets were entirely consumed and preserved their rectangular shape, even when in the form of ashes. I was pleased with the results of burning the briquets, and would use them regularly if they could be supplied at a price comparable with that which we pay for bituminous coal here, generally $8.50 per ton."

The remarkable spectacle of seeing old shoes, hats, paper, rags, straw, manure, house garbage, night-soil and a variety of other waste products, being thrown into one machine and emerging from another in the shape of a perfect fuel brick, is to be witnessed daily at the plant which is in operation at San Antonio. The finished product bears no resemblance to the raw materials that enter into its manufacture. The process performs the important work of sanitation, which is considered of the utmost importance in disposing of municipal garbage. In San Antonio the experimental plant is to be enlarged so as to handle the garbage of the entire city, a contract to this effect having just been entered into by the municipal authorities and the fuel company. The city commission of Austin, after a thorough investigation, decided to abandon its garbage incinerator and adopt the new process.

Dr. F. M. Gunn, of the Massachusetts Institute of Technology, who recently delivered a series of lectures on sanitation and garbage disposal at the University of Texas, expressed the opinion that the process which Mr. Culver invented is one of the most promising schemes so far advanced for handling city refuse.

The mechanical arrangement of the garbage fuel plant is simple. The refuse is unloaded from wagons upon a sorting

platform and sprayed with creosote as a sanitary precaution, as well as to allow the sorters to work with comfort. Thru holes in the platform the different kinds of garbage are dropped onto conveyors, which carry it to the various departments of the plant. The iron is carried into storage bins, dead animals are conveyed to the fertilizer department, bottles to the washing tank, ashes, stone and brick to a dump, tin cans to an incinerator, which removes the solder, and the remaining tin pieces are baled. All of the residue of the garbage is conveyed to the fuel-manufacturing department, where it is ground, mixed and made into bricks.

The entire plant is tightly inclosed so as to keep dust from escaping.

The cost of manufacturing the fuel bricks is about $1.80 per ton. They sell in San Antonio for $6.50 per ton.

Comparative Cost of Street Sweeping and Sprinkling with Mules and with Motors

The Street and Bridge Department of the Chicago (Ill.) Department of Public Works has made some careful comparisons of the cost of operating street sprinklers and street sweepers, both broom and pick-up, when drawn by mules and by motors, from which the following figures are taken.

In street sweeping, two Kelly-Springfield motor trucks hauled two street brooms and one Peerless motor sprinkler ran in advance of the two sweepers. Three mule teams hauled three street brooms, one mule-drawn sprinkler running in advance of the three sweepers. Three chauffeurs and seven men, including the foreman, made up the gang. The cost is tabulated as follows:

Sweeping—Motor-Drawn Equipment—Cost Per Day.

Three chauffeurs	$10.20
Two trucks hauling one broom each—	
Depreciation, charged off	4.70
Gasoline and lubricants	2.00
One motor sprinkler ahead of truck brooms—	
Depreciation, charged off	3.60
Gasoline and lubricants	1.50
Two broom men	4.00
Broom up-keep and depreciation	6.00
One-half of foreman	1.50
	$33.50

Sweeping 343,200 square yards street surface; cost, 9¾c per thousand square yards surface.

The actual cost for upkeep of motor equipment was $4.05 per day less than charged off on account of depreciation.

Sweeping—Mule Team Equipment—Cost Per Day.

Three teams hauling street brooms, one team sprinkling ahead.

Four teams, feed and depreciation	$6.80
Four men	8.00
One-half of foreman	1.50
Broom upkeep and depreciation	5.70
	$22.00

Sweeping 148,000 square yards street surface daily; cost, practically 15c per thousand square yards.

Pick-up Sweeping—Motor Equipment—Cost Per Day.

Two motor trucks, same as sweeping cost	$13.50
Ten men	20.00
One-half foreman	1.50
	$35.00

Picking up sweepings from 80 blocks of streets, 110,400 square yards street surface, cost reduced to $31.20 by virtue of excess in amount charged off, cost to pick up being actually only 28c per thousand square yards of surface.

Pick-up Sweeping—Mule-drawn Equipment—Cost Per Day.

Eighteen men	$36.00
One-half of foreman	1.50
Eight teams mules, feed and depreciation	13.60
Wagon and equipment depreciation	4.00
	$55.10

Picking up sweepings from 140 blocks of streets, 27½c per thousand square yards of street surface.

The cost of street sprinkling is tabulated as follows:

Sprinkling—Motor Sprinkler—Cost Per Day.

Chauffeur	$3.40
Oil and lubricants	1.50
Depreciation charged off	3.60
	$8.50

Sprinkling 624 blocks per day, 892,320 square yards surface; cost, practically 1c per thousand square yards of surface.

Sprinkling—Mule Equipment—Cost Per Day.

Eight men	$16.00
Eight teams of mules, feed and depreciation	13.60
Equipment depreciation	1.40
	$31.00

Sprinkling 1,280 blocks daily, 1,830,400 square yards of surface; cost, practically 1¾c per thousand square yards of surface.

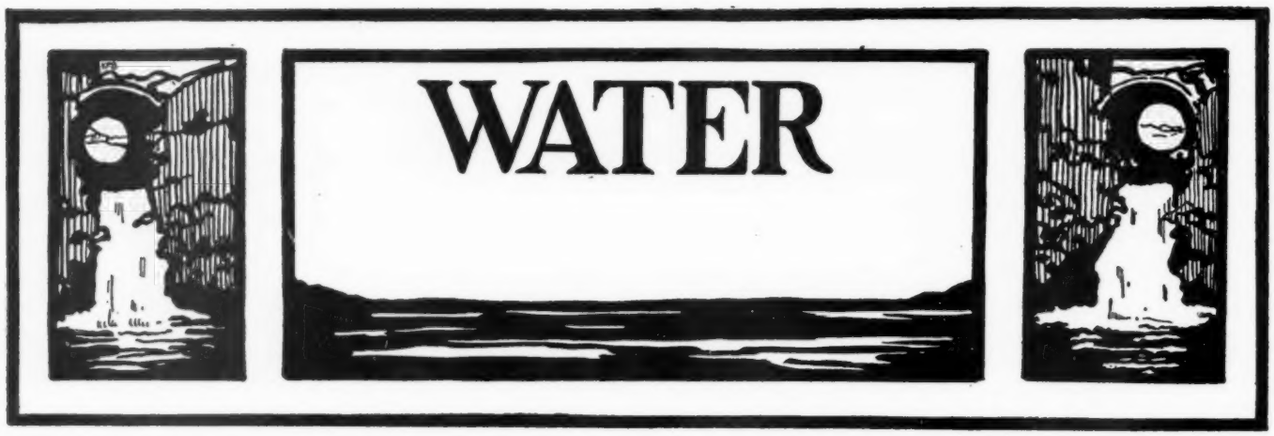
The motor equipment was actually operated two shifts a day, or 16 hours in all.

Rochester Can Specify Bitulithic

A further order in the case of Whitmore, Rauber and Vicinus against the city of Rochester, N. Y., the decision in which was reported in MUNICIPAL ENGINEERING, vol. xlvii, p. 455, has been entered. It may be remembered that the decision was to the effect that the city of Rochester can specify bitulithic as one of the kinds of pavement to bid upon and can let the contract for constructing a street with the same if the property owners designate it. The new order, issued April 7, is made in accordance with the order of the Appellate Division, to which appeal was taken from the original decision. It affirms the same and assesses on the plaintiff in the original case the costs of the contractor and of each of the city officials included in the complaint, some twenty-seven persons in all.

Specification of "A Sufficient Quantity" Is Valid

An ordinance for a street improvement, providing that, after the roadway had been rolled and compacted, a sufficient quantity of half-inch stone or torpedo sand should be spread on the surface, is not invalid because leaving discretionary powers to the public authorities.—City of Watseka (Ill.) v. Orebaugh et al., 107 N. E., 887.



Improved Water from Deep Wells in Northern Illinois

By C. B. Williams, Hydraulic and Sanitary Engineer, Chicago, Ill., before the Illinois Section of the American Water Works Association.

The geology of Northern Illinois is fairly well known from the numerous wells drilled thruout this district, but the quality of the waters supplied by various strata of water-bearing rock has not been so well investigated.

Most deep wells thruout this territory supply a water which is a composite, being a mixture of all good and bad water encountered in the sinking of the well.

The distinction between good and bad is not made from a sanitary standpoint, as most of the deep-well supplies are of unquestioned hygienic purity, but rather from their suitability for commercial and domestic purposes. Nearly all of these waters are unsatisfactory for boiler and laundry uses, as they are extremely hard and often contain objectionable iron salts.

In making a selection among the various strata of water-bearing rock, it is apparent that the lime rock may be eliminated as a medium for producing a soft water, hence we necessarily turn to the two sand rock strata as being the only possible sources for a satisfactory water. A study of the general information of these strata, the nature and conditions of their source of water supply, gives a clew to the kind of water we may expect to obtain from each.

The Potsdam sandstone lies just above the Archean bed and varies in thickness from a few hundred to over 1,500 feet, and is interspersed with layers of limestone and shale. Lying over the Potsdam sandstone is a rather thin, generally impervious blanket of limestone known as the lower magnesium. Over this limestone is the St. Peter sandstone, usually several hundred feet thick, which in turn is overlaid with the Trenton limestone, Hudson shale and Niagara limestone successively, the latter two having been eroded in the central part of the field.

These successive layers of rock rise gradually toward the north and west and outcrop in Wisconsin, Minnesota and Northern Michigan. The Archean rock outcrops the farthest north, in a broad irregular area, extending as far south as Chippewa Falls and Wausau, Wis. South of the Archean rock is the Potsdam outcrop in a V-shaped belt covering about 14,000 square miles, the apex of the V extending as far south as Madison, Wis. Next south is an outcrop belt of lower magnesium limestone and southerly from this is the outcrop of the St. Peter sandstone in Southern Wisconsin and Northern Illinois, having an area of about 2,000 square miles.

These outcrops, mostly covered with a pervious blanket of soil and gravel, are the intakes, so to speak, of these sandstone underground channels. The general surface drainage of the main part of this territory of Wisconsin is south and southwesterly, hence the numerous streams crossing the Potsdam outcrop rise in and flow over the Archean and sand rock and are less liable to become charged with lime and magnesium salts; on the contrary, the streams feeding the St. Peter sandstone have previously traversed the limestone district of the lower magnesium outcrop, thereby becoming impregnated with the hardening salts of lime and magnesia.

Thes eobservations would lead us to believe that the Potsdam sandstone would furnish a softer water in general than that from any other strata, and as a verification of this the results obtained from some wells sunk in Cook County are of interest.

The Chicago, Milwaukee & St. Paul Railway Company and the Chicago & Northwestern Railway Company have both successfully improved their water supply for boiler purposes by casing off portions of the waters sunk in their wells. Also the village of Western Springs has sunk a deep well and cased out certain waters, thereby greatly improving its supply, but not to the same extent as in the case of the railroads.

The Milwaukee wells are located on the Chicago & Council Bluffs division, about two miles west of Mannheim. There are at least five, the records of which are available, and all of which show similar characteristics.

The log of well No. 1, following, is typical:

Ground level, 679 feet above sea level.

Niagara limestone, from	62 ft. to 260 ft.
Hudson shale, from	260 ft. to 455 ft.
Trenton limestone, from	455 ft. to 785 ft.
St. Peter sandstone, from	785 ft. to 1,060 ft.
Lower magnesium limestone, from	1,060 ft. to 1,262 ft.
First Potsdam sandstone, from	1,262 ft. to 1,450 ft.
Limestone, shale, etc., from	1,450 ft. to 1,705 ft.
Second Potsdam sandstone, from	1,705 ft. to 1,804 ft.
Limestone, from	1,804 ft. to 1,820 ft.
Third Potsdam sandstone, from	1,820 ft. to 2,290 ft.

Caves were encountered at 570 to 590 feet, 1,060 to 1,070 feet and 1,085 to 1,095 feet. These caves were taken care of by casing. The lower and third Potsdam sandstone is composed of beds of different thickness, color and hardness.

The well is cased from the surface to a depth of 1,262 feet, where the casing is sealed to the rock walls by concrete.

The following are the analyses of the water at various depths below the casing, given in grains per gallon:

Depths in Feet	1,450	2,030	2,128	2,290
Oxides	Undet.	Undet.	Undet.	Undet.
Calcium carbonate	2.94	5.34	6.64	10.22
Calcium sulphate	4.61	....	....	3.95
Magnesium carbonate	.27	2.10	2.87	3.88
Incrustating solids	7.82	7.44	9.51	18.05
Alkali carbonates	....	7.81	8.92	....
Alkali sulphates	7.47	10.50	4.82	3.17
Alkali chlorides	3.38	4.68	12.44	50.96
Non-incrustating solids	10.85	22.99	26.18	54.13
Total	18.67	30.43	35.69	72.18

This well, which is the deepest, shows a large increase in incrustating solids toward the bottom, and also a large increase

in salt contents. This was avoided in the other wells of the series by lessening the depth by about 50 feet. The yield of these wells varied from 130 to 170 gallons per minute.

The Northwestern Railway drilled a chain of wells at Proviso, Cook County, Ill., on the Galena division, about four miles south of the Milwaukee wells. These wells were spaced from 300 to 600 feet apart, and all showed similar characteristics as to depth of strata and as to quality of water. The log of well No. 3 is typical.

Surface of ground, elevation above sea level, 645 feet.

Niagara limestone, from	73 ft.	to	245 ft.
Hudson shale, from	245 ft.	to	478 ft.
Trenton limestone, from	478 ft.	to	810 ft.
St. Peter sandstone, from	810 ft.	to	1,010 ft.
Lower magnesium limestone, from	1,010 ft.	to	1,220 ft.
Sandy shale, from	1,220 ft.	to	1,320 ft.
First Potsdam sandstone, from	1,320 ft.	to	1,520 ft.
Limestone, from	1,520 ft.	to	1,747 ft.
Second Potsdam sandstone, from	1,747 ft.	to	1,830 ft.

Caves were encountered here only between the St. Peter sandstone and the lower magnesium limestone. This well was cased to a depth of 1,690 feet and was only drilled to a depth of 1,830 feet. The following is an analysis from the water at that depth given in grains per gallon:

Calcium carbonate	4.20
Magnesium carbonate	1.46
Iron and aluminum	0.06
Silica	0.46
Incrustating solids	6.18
Alkali chlorides	4.10
Alkali sulphates	4.04
Alkali carbonates	10.08
Non-incrustating solids	18.22
Total	24.40

This well, as the others in the series, were cased to a greater depth than the Milwaukee series on account of the poor quality of water found in the first Potsdam sandstone. The yield varied from about 60 to 150 gallons per minute, and the pumping of two alternate wells 600 feet apart to a depth of 242 feet lowered the water in the third intermediate well 97 feet.

The village of Western Springs, Ill., has just completed a well in which the results obtained conform generally to those found in the Milwaukee and Northwestern wells.

This well is ten miles due south of the Milwaukee well in the township of Lyons about one-half mile from the west line of Cook County.

The following is a log of this well:

Surface of the ground above sea level, 648 feet.

Niagara limestone, from	73 ft.	to	360 ft.
Hudson shale, from	360 ft.	to	474 ft.
Trenton limestone, from	474 ft.	to	790 ft.
St. Peter sandstone, from	790 ft.	to	1,244 ft.
Lower magnesium limestone, from	1,244 ft.	to	1,337 ft.
First Potsdam sandstone, from	1,337 ft.	to	1,490 ft.
Limestone, from	1,490 ft.	to	1,765 ft.
Second Potsdam sandstone, from	1,765 ft.	to	2,046 ft.

This well was cased down to a depth of 1,765 feet, as the waters from the first Potsdam and underlying limestone were very unsatisfactory, as may be seen from the following analyses, given in grains per gallon.

	Above 1st Potsdam 1,337 ft.	1st Potsdam & Limestone 1,337-1,765 ft.	Below Casing 1,765-2,046 ft.
Calcium carbonate	21.33	21.46	13.42
Calcium sulphate	3.74	1.11	....
Magnesium sulphate	15.11	15.12	2.10
Iron carbonate	....	.27	.12
Undetermined	.55	2.21	.99
Incrustating solids	40.63	40.17	21.43
Sodium sulphate	2.69	5.45	8.85
Sodium chloride	.29	.77	24.06
Sodium nitrate	....	.04	....
Non-Incrustating solids	2.98	6.26	32.91
Total	43.61	46.43	54.34

This well is rather unique in that in placing the casings the one thru the drift is made big enough to allow small suction pipes to be dropped between it and the inner casing, thus making the water from either the upper or lower strata available. The available supply from the lower strata for a draw down of 150 feet was about 110 gallons per minute.

A study of these three wells bears out to a large degree the assumption that the Potsdam sandstone will give a more satisfactory water than the St. Peter sandstone. It also is evident that all parts of the same strata cannot be relied upon to give exactly the same quality. This is shown by a comparison of the water from the first Potsdam of the Milwaukee well, which shows 7.82 grains per gallon of incrustating solids, while the same stratum in the Northwestern well was reported as bad and the Western Springs well showed 40.17 grains per gallon.

It further appears that increasing the depth beyond a certain point will probably increase the hardness without any great return in quantity of water, and that the capacity is limited to approximately 170 gallons per minute, according to the tests on these wells. In the territory around Chicago, at least, a limit to the depth is fixed by the increased amount of salt in the lower levels.

More data are needed to establish the conclusions as drawn from these limited areas, and they should cover the territory more completely. If, with more data, it is found that the above conclusions are generally borne out, it opens up an improved supply for small towns and industrial establishments that may be well worth the extra cost to obtain.

Efficient Municipal Operation of Clarksburg Water Works

Officially declared by high authority to be the best conducted public office in West Virginia, the report of the audit of the accounts and transactions of Scotland G. Highland, secretary and general superintendent of the Clarksburg (W. Va.) Water Works and Sewerage Board, covering a period of eight years, from 1907 to 1914, has been filed by State Tax Commissioner Fred O. Blue. The receipts for the period were $503,824.93, and of this sum approximately $400,000.00 were expended in enlargement and betterment of the system.

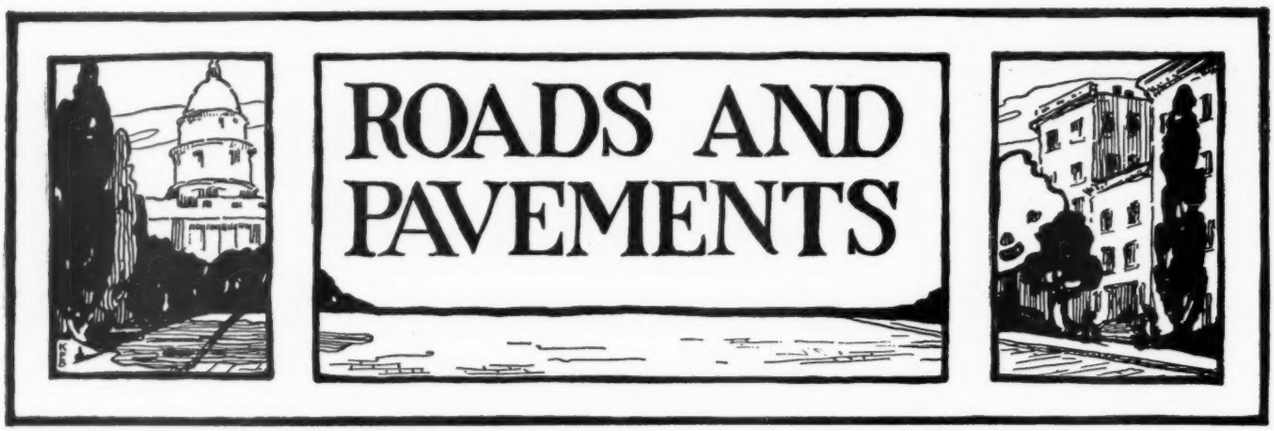
The State Tax Commissioner says: "The examination discloses that the financial records of the board are well kept and entries made up to date. We find that losses on account of delinquent water rents amount to practically nothing, rentals being charged to the property owner. It is the practice to purchase supplies and materials on quotations from bidders and discount bills by cash payment. Receipts are shown for all moneys paid out on the labor pay rolls. A minute record is kept by the secretary and all disbursements made by the board are shown on this record."

At the close of the audit period there was a cash balance on hand of $15,614.83, showing the department to be a financially sound institution.

Mr. Highland is the author of several valuable water works books and is a liberal contributor to the technical press on water works subjects. He is chairman of the national committee on "Sanitary Plumbing" of the American Water Works Association and is widely known among water works men thruout the country.

Mr. Highland is considered an authority on the subjects of sanitary control of waterways and sewage disposal and the bill of which he was author pertaining to these subjects had many strong supporters in the last West Virginia legislature.

Business men interested in public health work, civic organizations and heads of water departments will shortly begin a campaign for clean waterways, and for the preservation of the natural purity of the potable mountain streams of West Virginia, famous for their coolness and salubrity.



Replacing Brick Pavements After Street Excavations

By P. J. Masterson, Superintendent of Street Repairs, Cleveland, O.

So much of the mechanism of a modern city lies under the surface of its streets that the question of street repair is scarcely less vital than that of good original paving construction, if streets are to be constantly serviceable. The excavator is the worst foe of any pavement and the efficient repair man is its best friend, and will be so long as sewer, water, gas, phone, power and steam lines are laid in conduits or trenches.

Foresight will cut down the number of openings that it is necessary to make in a completed pavement, but no pavement is ever laid in a growing town without the certainty of being disturbed from time to time. In Cleveland, where we have a preponderating mileage of brick streets, it has been necessary to work out careful methods for the replacement of brick paving that has been disturbed. While the process calls for workmanlike exactness, we pride ourselves on patching brick streets so that their strength is unimpaired, and, in many instances, so that the patch cannot be noticed at casual observation. This is more than can be said for some other forms of pavement.

Our first precaution is to have the city relay all of the disturbed pavement. Service corporations and other private concerns are permitted to make openings in streets upon filing proper application. With this application must come a deposit sufficient to cover the cost of replacing the pavement. The city inspects the methods of excavation and particularly dictates the methods of backfilling. But when it comes to the actual repaving, no one but the employes of my department are entrusted to do the work. The cost is deducted from the deposit and the balance, if any, returned to the party making the excavation.

I am a firm believer in the policy of compelling the return of all excavated earth to the trench. Only in the case of rock excavation would I make any exception. It may be argued that the pipe or conduit takes up a certain amount of space and therefore a corresponding volume of earth may be left out of the trench. But experience shows that, by tamping, more earth can always be returned to a trench than was removed from it, and the practice of requiring it all to be returned leaves no pretext for spongy backfills, which are a dangerous menace to the security of any pavement.

In replacing a brick pavement over a trench, we adhere closely to the original specifications used in constructing the pavement, leveling the sub-grade and laying, successively, the concrete base, the sand cushion and the brick.

The joint of the completed patch with the original pavement must, of course, be in the original serrated pattern. In making the cut thru the pavement, alternate brick will sometimes be broken in the middle, leaving a series of broken bricks along the edge of the cut. These half bricks must be "toothed" out with a chisel. We use one about eighteen inches long, so that none but whole bricks remain. It is then possible to break joints in patching. A patch which does not dove-tail into the original pavement, but leaves a long straight longitudinal joint between patch and pavement, cannot be too strongly condemned.

I may remark that a long-handled chisel is the best instrument to use in making the original cut in a pavement. After an opening has been broken with a maul, the chisel can

TRENCH FILLED *and brick paving toothed so as to cut out all broken brick and leave good surfaces to join with the new brick laid over the trench.*

BRICK REPLACED OVER CONDUIT *in East Ninetieth street, Cleveland, O., showing the matching of bricks and uniformity of repaired surface with the original pavement which can be secured by proper methods of repair.*

be used to cut and pry out each brick separately, making a cleaner opening and facilitating the patcher's job.

Matching brick for the patch is an important matter. If the color and size coincide with the original pavement, the patch will be scarcely noticeable. The brick should be carefully measured in matching for size. Where the new brick are a hair's-breadth thicker than the old ones, the courses are thrown out of series and good joints are impossible.

The proper compacting of the sand cushion presents a difficulty that is not found in new jobs of paving. Sand has probably been lost from the original cushion during the excavation and it is necessary not only to compress the sand cushion downward in making the repair, but to force it laterally under the edges of the old pavement. For this purpose we use a form of sand rammer, consisting of an iron handle six feet in length, with a rectangular head turned at an angle of 45 degrees from the line of the handle. This compacts the sand at the edge of the cut and an ordinary wooden rammer or a narrow hand roller does the same service for the width of the patch.

Grouting must be done with care and exactness, two to four applications being swept into the joints and the brick swept clean at the last application. The remaining part of the task is simple precaution against disturbances while the grout is setting. The patch should be covered with three inches of moist sand and barricaded for a period of ten days or two weeks. It is a good extra precaution to barricade the entire street, where conditions permit, and thus avoid the jar of passing vehicles. But this is rarely possible on the ordinary busy street, so the best that we can do is to keep traffic off from the patch during the period of setting.

These were the methods used in replacing over 42,000 feet of pavement last year. Our department deals with many kinds of pavements and while there are others upon which superficial repairs can be made more easily and promptly, there is none in which the original strength of the pavement is more fully restored than in a brick pavement where there is due care in the workmanship and a careful selection of materials.

Illinois Specifications for Concrete and Brick Pavements

The new specifications for concrete and for brick road construction, under state aid, of the Illinois State Highway Department, have been issued.

They provide for furnishing of cement and machinery for construction by the department, if so desired. In such case the specifications provide:

"Cement will be furnished the contractor for the work in hand, without charge, under the following conditions:

"He must notify the engineer in writing at least twenty (20) days in advance of the time he expects to be ready to use the cement, and he shall also indicate the amount per day he expects to use.

"The contractor must be prepared to unload and properly protect all cement from the weather and dampness, and he will assume and be responsible for all demurrage charges.

"The contractor shall assume all responsibility for the value of the cement sacks from the time the seal is broken on the freight car door until the credit memorandum for the return of the sacks in a satisfactory condition is issued by the cement company. The value of the missing or damaged sacks indicated on the memorandum shall be withheld from the amount eventually due the contractor.

"All cement sacks shall be collected, cared for, bundled, carted and shipped, freight prepaid, back to the cement mill, all in accordance with instructions below, and entirely at the expense of the contractor. The contractor shall be reimbursed for the prepaid freight, plus 10 per cent. (Here follow the instructions for returning empty cement sacks as provided by the cement companies.)

"If any cement is damaged by dampness or otherwise, after removal from the cars by the contractor, he shall be charged with the cost of the same, including freight charges, and all such amounts it is hereby agreed are to be withheld from any sums that may be due the contractor under the terms of this contract.

"If for any reason the state does not furnish the cement at the time it is needed, then the contractor may, with the written consent of the State Highway Commission, purchase the cement on the open market and will be allowed therefor only the prevailing market price at the time.

"The cement will be ordered by the state for delivery at the time and in such quantities as the contractor may indicate is required, but cement will not be ordered in less than carload lots.

"It is expressly understood by the contractor that no responsibility is assumed by the State Highway Commission for the delivery of the cement at the time desired and that no claim for any extra compensation is to be made by the contractor except as hereinabove stipulated.

"If any machinery is to be furnished the contractor, there will be inserted a paragraph, on a separate sheet of paper, stating specifically just what machinery and the conditions under which it is to be furnished."

The specifications differ in detail from the standard specifications adopted by the American Society of Municipal Improvements, in all but one item, being somewhat more severe. Cement is required to meet the specifications in Circular No. 33 of the U. S. Bureau of Standards rather than the American Society for Testing Materials.

Not more than 3 per cent. of clay and loam combined is permitted, rather than 7 of the standard specifications.

The largest size of coarse aggregate is 1½ rather than 2½ inches and co-efficient of wear (8) and toughness tests (6) are required, and certain percentages of three grades of size of coarse aggregate (1½, ¾ ¼-inch round mesh), and of four grades of fine aggregate (¼, 1/16, 1/50 and 1/100-inch) are required. Gravel must be separated and again mixed in the proper proportions of the specified sizes before using.

Proportions of materials are: 1 cement, 2 fine aggregate and 3½ coarse aggregate, by volume, a sack of cement being 0.95 cubic foot, as compared with 1 to 2 of fine and coarse aggregate and 1 bag (94 pounds) of cement to 4 cubic feet of concrete in place for single-course pavement of the standard specifications, which also provide for a 2-course pavement, the lower course as above, but with 1 bag of cement for 5 cubic feet of concrete, and a 1-inch wearing surface of 1 to 2 cement and fine aggregate.

The specification requires 1.61 barrels of cement per cubic yard of cement, assuming 40 per cent. voids in the coarse aggregate, subject to change if voids are more or less than 40 per cent., as against 1.69 barrels required by the standard specification for single-course pavement.

The engineer compares the calculated amount of cement required with the actual amount used each day, and if the latter is 2 per cent. too low the contractor agrees to replace the concrete without charge. If it is more than 2 per cent. in excess, the contractor is charged with the value of the excess. The cement being furnished by the state, this operates simply to make the contractor exact in his measurements.

At least twelve turns of the mixer are required, and water is added as the other materials are run in, rather than after the dry materials have had a thoro mixing. The definition for consistency is also quite different.

Joints are provided for every 100 feet and at the close of each day's work, but not less than 40 feet apart, as compared with 30 feet regularly in the standard specifications. A bituminous filler for temperature joints is specified in detail.

Finish of surface, covering for curing, tests for crushed stone macadam, earth or bituminous shoulders, earth or concrete gutters, are also provided in some detail.

Unless certain of these specifications have been worked out carefully to suit the best materials available, they may result in material increase in cost over construction under the standard specifications without corresponding increase in value.

In the specifications for brick pavements the width of blocks is made 3¾ instead of 3½ inches, a departure from the endeavor of manufacturers and engineers to make the sizes standard. Straight wire-cut brick are excluded.

The average loss in the abrasion test is fixed at 22 per cent. or less, no individual brick to exceed 26 per cent., except wire-cut-lug bricks, which are allowed 23 and 27 per cent., respectively.

Finer sand is used than under the standard specification—⅛-inch instead of ¼-inch to 50-mesh.

Fine aggregate for concrete base, in addition to rather more severe specifications than the standard, must make briquettes of 1:3 mixture equal in tensile strength to briquettes made 1:3 with standard Ottawa sand and the same cement.

As in the specifications for concrete pavements, the requirements for fine and coarse aggregates may materially increase cost unless the local materials conform closely with them, while not very materially improving the product under standard specifications; so will the requirement that gravel must always be graded, and then remixed in the fixed proportions.

Sand for grout filler is less than 1/16-inch instead of the standard, between No. 20 and No. 100 sieves.

A longitudinal expansion joint at one curb of ⅜-inch wool felt, treated with tar or asphalt, is specified instead of the standard 1-inch bituminous filler expansion joint at each curb.

A batch mixer for concrete is definitely specified, and at least twelve turns of each batch before discharge.

Side forms of 2-inch plank or steel are specified in detail.

In other particulars these specifications agree quite closely in intent with the standard specifications. It may be said that as a whole they are not as strict as the standard specifications. They probably secure a pavement fully equal to the traffic over country roads and a cost somewhat less than that of the standard city brick street pavement.

Difficult Construction of Concrete Road

The Cedar Point automobile road just completed for the Cedar Point Improvement Company is a private boulevard projected for the purpose of connecting with the mainland the summer resort located on the northern extremity of a sand bar averaging 200 feet in width and about 8 miles in length, which divides Sandusky Bay from Lake Erie. There were some difficulties as to foundation and as to methods of construction, and the manner of overcoming these difficulties is of much interest.

The new road is designed for motor-driven traffic exclusively. The total length is 7 miles, of which 6 miles is along the summit of the sand-bar adjoining the lake side and closely following the long curve of the shore line. The remaining mile is across the marsh land lying between the bar and the mainland and on the main land to the main public road known as the "Lake Shore Road," now being improved by the Ohio State Highway Department as a part of the system of main market roads.

The general type of construction is a 6-inch concrete found-

FILL ACROSS MARSH, *two thousand feet long, which was settled sufficiently during the period of construction to permit construction of concrete pavement. The concrete was reinforced with woven wire, however.*

CEDAR POINT CONCRETE ROAD *in winter. The bank was covered with stone to withstand the action of the ice which is forced against it by wind and waves. The concrete of the pavement was finished, but the bituminous wearing surface had not been applied when this photograph was taken.*

ation 18 feet in width, covered with a wearing surface of bitumen and gravel. Adjoining the concrete on each side is a 3-foot strip of macadam, the total width of available driveway being 24 feet. The main entrance for a distance of 1,200 feet is paved with concrete 24 feet wide, with concrete curbs and concrete walks. One section, 2,000 feet in length, crossing the marsh on an earth fill, is reinforced with woven-wire triangular-mesh reinforcement.

Asphaltic felt expansion joints, ½ inch thick, were placed transversely 33 feet apart, but expansion was so excessive that slab lengths were finally reduced to 20 feet The concrete is composed of 1 part Medusa portland cement, 3 parts sand and 5 parts crushed stone, this mixture being adopted after a careful analysis of the available materials, and with a view to the ultimate requirements of the pavement and the various other conditions peculiar to this road.

The greatest difficulty encountered in the construction of the road was due to the fact that the entire length was practically isolated from connection with the outside world, at least for purposes of construction; and that transportation of any kind was impossible along the route of the road. All materials, supplies and equipment had to be handled from the south terminal, located seven miles from the city of Sandusky, being brought to that point over an electric interurban railway, and there transferred to a narrow-gage railway built in advance of the construction of the road.

The road after leaving the south terminal, or entrance, runs north for 3,000 feet on the mainland, then crosses the marsh on an earth embankment 2,000 feet long, to the sand bar which separates the marsh from the lake, and thence along the top of this sand bar to the Cedar Point resort, which occupies the northerly end of the peninsula.

The construction of the embankment across the marsh was started in the winter of 1912-13, the railway track being laid directly on the ice. Material was brought from the excavation for the roadway between stations 4 and 30, in 5-yard dump cars, and pushed ahead of the locomotive out onto the fill as far as the track would safely support the train. In dumping it was usually necessary to chain the trucks to the track, as the unstable character of the latter allowed tilting sufficient to cause derailments. The track was immediately jacked up, the material shoveled under it and tamped around the ties, and work continued upon one section of track about the length of a five-car train until an embankment 3 feet high and 20 feet wide on top was completed, before extending the embankment the length of another section. The material was excavated and loaded with picks and shovels, altho a steam shovel would have been considerably cheaper and would have shortened the time of construction materially. The loading crew averaged ten men besides foreman, plow team and driver; the train crew consisted of engineman and brakeman; the embankment end was handled by four men spreading the dirt and four men raising, shifting and maintaining the track. The cars are usually loaded to 6-yard capacity, loose material, and handled in 5-car trains, the average rate being about one train per hour and seldom exceeding a rate of one and one-half trains per hour, the rate being largely controlled by the progress made by the track crew in maintaining and extending the spoil track.

The embankment was carried in this way entirely across the marsh and then widened and raised to approximately the finished section, with allowance for shrinkage, the weight of the material being sufficient to settle the surface of the marsh gradually during construction. This marsh surface varied in thickness from three to eight feet, the settlement of the bottom of the superimposed fill in general being about half of that amount. As most of the earth that was used entered the fill in a partially frozen condition, the shrinkage was quite marked after the spring rains and the high water in the marsh saturated the embankment, and considerable difficulty was encountered in maintaining the track, even after the top crust of the embankment became hard and dry; but a liberal use of crushed

CEDAR POINT CONCRETE ROAD *under construction. Concreting gang in the rear, concrete covered for curing in foreground. Service industrial railroad on left supplies materials.*

stone ballast solved the difficulty in a very satisfactory manner.

The original plans provided for the roadway on this embankment to be built of bituminous macadam, on the supposition that the embankment would not have reached a condition of sufficient stability by the time it was necessary to complete this gap in the pavement, to admit the laying of a concrete pavement without danger of excessive cracking. However, delays in completing the balance of the work allowed this section to be left open during the following winter and spring, so that when the time came to complete the section, measurements indicated that the settlement had practically ceased, and it was determined to continue the concrete pavement across this section, using a cross-section 7 inches thick in the center and 5 inches at the sides, reinforced with woven wire. American Steel and Wire Company's No. 28 triangular mesh, 58 inches wide, in rolls 150 feet in length, was used, four strips laid lengthwise giving about 6 inches overlap, 1-inch transverse expansion joints being placed 150 feet apart. This section has been in use about nine months under average traffic conditions, and so far has shown no evidence of cracks or unusual settlement, although no measurements have been made to determine whether or not there has been some degree of uniform settlement thruout the section.

Clifford M. King, civil engineer, Sandusky, O., was the engineer in charge of design and construction. W. S. Pace, of Chicago, was the contractor. We are indebted to Mr. King for the data regarding methods of construction and photographs showing the nature of some of the special conditions met with. The success of the construction may lead others to attack similar problems of like nature, which have seemed well-nigh impossible.

Brick Pavement on Old Macadam Base

By Ett S. Smith, County Engineer of Mahoning County, Youngstown, O.

To save Mahoning county's investment in macadam roads, after the traffic had far outgrown the durability of such a surface, was a problem that confronted me as county surveyor in 1910. The problem has been solved by utilizing the macadam as a base for a modern brick surface. As a result we have many miles of rural brick road in Mahoning county which compare favorably, in point of service, with brick construction that is installed from the ground up in a single contract and is superior in point of having a thoroly settled base.

As many other localities have an extensive mileage of macadam, unsuited to the traffic and imposing a heavy annual charge for maintenance, an account of my methods may be of interest. In a very large number of cases, I am satisfied, the cost of annual repairs will much more than pay interest and depreciation charges on a brick surface expenditure. Brick requires practically no repairs and the public is freed, not only from the expense, but also from the nuisances that arise from continued road work, or even the worse condition, that of continued out-of-repair state.

The first road resurfaced was the Youngstown-Boardman pike leading southerly from Youngstown. This was done in 1912. At first it was planned to resurface only a few hundred feet, but when the economy of this arrangement became apparent, coupled with the satisfaction it afforded to users, we concluded to carry the improvement a distance of four miles.

The Youngstown-Canfield road, two and one-half miles in length, was laid the same year, and another mile was added the following year. The Boardman road leads toward the fertile fruit and gardening country of Columbiana county, so that it is subjected to a heavy traffic from market wagons, and its improvement has a decided effect in stabilizing the supplies that come to the Youngstown market.

Several stretches of county road, now included in the city limits, were saved from deterioration in the same way.

In 1913, Belmont avenue was brick surfaced to the county line, and the following year the same type of construction was continued for a mile and a half into Trumbull county. Hubbard road was paved for three-quarters of a mile, and the county of Trumbull has also taken up this work and carried it to the village of Hubbard, three and a fifth miles distant.

On several of these roads it would have been better to make the improvement twenty feet wide, rather than the sixteen feet which the state law prescribed. In two instances, however, the sixteen-foot limit was exceeded. A half mile of paving on Logan avenue was laid thirty feet wide at the instance of property owners, who, with the traction company, bore the additional expense. In the other instance a part of the Hubbard road, with the assistance of the property owners, a thirty-six-foot pavement was laid where there had formerly been a fourteen-foot macadam road.

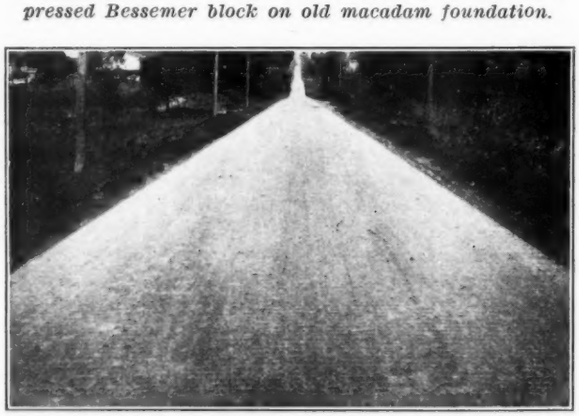
The total mileage of brick has now reached thirty-six and one-half miles, of which seventeen miles have been laid on maradam, and more paving of this type will be laid during the coming year.

Our methods of surfacing were simple. Where the road was rough it was scarified and new stone used to fill the depressions. Where the old surface was smooth and level, we disturbed it as little as possible. Stone curbs 4x12 inches in size were set on the two sides of the road. New road metal was used to extend the width of the macadam from fourteen feet, its original width, to the required sixteen feet. Over this macadam surface we laid a course of finely granulated slag, a material which is easily secured from local blast furnaces, and on the slag cushion our brick surface was laid.

Much credit is due to the contractors for the success of these roads. They took a genuine interest in the quality of the job, and the grouting, in particular, was done in a workmanlike manner. Kennedy Brothers and Hannan Brothers divided the work on the Boardman road. Kennedy Brothers and Kain & Smith built the Canfield road. The McGuffey, Belmont and Hubbard roads were built by James McCarren.

A road from Youngstown to Akron is being built by state aid and is destined to be one of the most used inter-county highways in the state. Nearly six miles of this road will be constructed this year over an old macadam road between the towns of North Jackson and Austintown Center, Mahoning county, upon specifications similar to those which I have described.

BOARDMAN ROAD, *near Youngstown, Mahoning County, Ohio, five miles long, resurfaced with repressed Bessemer block on old macadam foundation.*



MISCELLANEOUS

F. H. NEWELL, *in charge of Department of Civil Engineering of Illinois University, Urbana, Ill.*

The New Professor of Civil Engineering at Illinois

Frederick Haynes Newell, who has recently been appointed Professor of Civil Engineering and head of the Department of Civil Engineering of the University of Illinois, entered upon his duties on May 1, in order to be fully prepared for active work at the beginning of the next college year. He has been for twenty-six years in government service, principally as chief engineer and later as director of the United States Reclamation Service.

Professor Newell graduated at the Massachusetts Institute of Technology in 1885 in mining engineering, and then took post-graduate work in geology and hydraulics. Later he found employment in the oil regions of Ohio and in the coal areas of Virginia. He was designated as assistant hydraulic engineer of the United States Geological Survey on October 2, 1888, this being the date of the first appropriation by Congress of funds to investigate the extent to which the arid regions of the United States might be reclaimed. Starting as the first person appointed under this act, Professor Newell continued for over twenty-six years to devote his energies to the Reclamation Service.

This bureau, having charge of the expenditure of over $80,000,000 appropriations beginning in 1902, was organized by or under Professor Newell, as it was in effect an outgrowth of the investigations started under the United States Geological Survey, and was largely initiated and guided by him from the period of preliminary study to that of final completion.

The Reclamation Service under Professor Newell's direction has constructed some of the largest dams and storage reservoirs in the world with systems of canals for distributing the stored water to about three million acres of agricultural lands. The engineering operations have embraced not only civil and hydraulic, but also hydro-electric, railway, mechanical, mining, structural, sanitary and other problems.

Growing steadily but rapidly from a single individual, the organization expanded until several hundred engineers, technical and clerical assistants have been employed, and a force of upwards of eight thousand laborers. The wide distribution of the work necessitated a quite elaborate and yet flexible organization, and the problems encountered have required the exercise of engineering and business judgment to a high degree. Frequently investigated by congressional committees and by special boards of engineers or experts the results have been commended both for economy and efficiency, and no shadow of distrust has been cast upon them. The devotion of the members of the service to the public welfare has been conspicuous and has attracted much favorable comment from foreign engineers and well-informed citizens. Much of this has been due to Professor Newell's personal influence and to his careful selection of men.

The broad experience had in discovering conditions in initiating large work, in overcoming unusual difficulties, in attracting and holding men of high character and sharing with them an enthusiasm and a rare devotion to public service leads to the hope that Professor Newell in his new position may be of substantial aid in maintaining and forwarding the high ideals of Illinois University

London in the Dark

By Raymond K. Cummings.

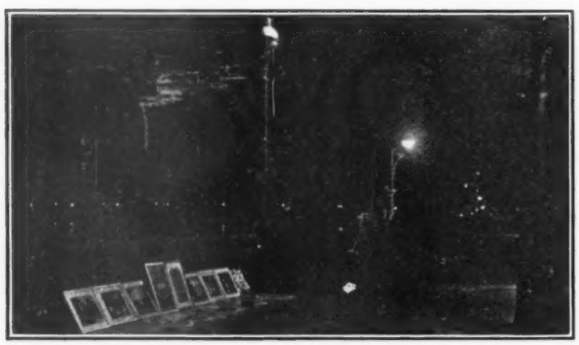
We read of "darkened London," but details of the actual conditions in the world's metropolis somehow never seem to have been printed. The English are not really afraid of a German air raid, or, if they are, they will not admit it, even to themselves, but nevertheless they are neglecting nothing to minimize the danger. In the first place, all the ordinary street lamps of the city are painted black on the top and sides, or have little black oil-cloth caps fitted on them. The bottoms of the lamps are left white, and thus the effect is to throw a narrow beam of light straight down thru the fog, striking the pavement as a slightly larger round spot of light. All advertising signs are kept dark; shopkeepers' windows are not lighted, except in some cases where a light has been specially

HOUSES OF PARLIAMENT *from the river side, with darkened lights.*

designed that throws its illumination inward, and, while showing up a portion of the window contents, reflects hardly any glow into the street. Railway trains entering and leaving London bear in each compartment a sign to the effect that, "Owing to the present crisis, passengers are requested to pull down all blinds as soon as the lights are lighted," and the order is nearly always obeyed.

Altho, of course, London cannot be hidden, even were all lights reduced below the minimum of absolute necessity, it seems to be the aim of the government to so disguise its familiar landmarks and to create false landmarks, that a hostile airman would have difficulty in locating any building he spe-

THE THAMES EMBANKMENT, *with darkened lights. The bridge in the background is the same shown in the preceding photograph. Note darkened tops of globes of the lighted lamps.*



THE EMBANKMENT *as it is lighted in time of peace, showing the contrast with the preceding war-time photograph.*

cially desired to hit. To this end, while the streets themselves are darkened, some of the open spaces of the parks have long parallel rows of little acetylene lights quite close to the ground. These, when lit at night, convey from above the impression of looking down upon a street or boulevard.

Another interesting and ingenious device concerns Picadilly Circus. The customary arrangement of lights here is supposedly familiar to German airmen. The circle is therefore rather more than ordinarily darkened, and an imitation Picadilly Circus, having the same light arrangement, has been constructed, and is set up in different parks of the city, changed in locality from time to time. So that it is hoped, should a German air fleet succeed in getting over London, the aspect of the city will be so changed and some of its apparently familiar spots wrongly located, that bombs aimed at notable buildings or important points will altogether miss their mark.

Preparations for active defense against an air raid are, of course, in force, and day and night aeroplanes and aviators are ready to ascend at the warning of sentries, who patrol the roofs of all the public buildings.

And so London awaits, with a remarkable calmness and an almost morbid curiosity, the coming of the German air fleet, that all its better-class citizens regard as inevitable. As to what will happen few do more than hazard a guess, but all hope that "London in the dark" may prove an effective defense against the long-heralded German attack.

Technical Associations

At the last meeting of the Indianapolis-Lafayette section of the American Institute of Electrical Engineers, A. R. Holliday discussed "Rural Electrical Development in Indiana," in which he has had a prominent part.

The nineteenth annual meeting of the National Fire Protection Association was held in New York, May 11-13. F. H. Wentworth, secretary, 87 Milk street, Boston, Mass.

The Municipal Art Society of New York receives drawings until May 22 in competition for prizes of $300, $200 and $100 for the best architectural solution of the intersection of two streets, which, by the description, are probably Fifth avenue and Forty-second street, New York, to provide for the handling of the heavy traffic on the two streets, which now produces great congestion at the crossing of the two double streams, one in each direction on each street.

For its meeting, May 13, the Brooklyn Engineers' Club has scheduled a paper by Charles Ekstrand on "Asphalt, Its History, Manufacture and Uses."

The Pan-American Road Congress will be held at Oakland, Cal., during the week of September 13. This date was fixed upon, owing to the advantageous arrangements that could be made for halls for meeting places, and to enable engineers to attend also the International Engineering Congress. It will be held under the joint auspices of the American Road Builders' Association and the American Highway Association, by an executive committee of five, of which Governor Charles W. Gates of Vermont is chairman, and the other members are James H. MacDonald, former state highway commissioner of Connecticut; Major W. W. Crosby, former state highway engineer of Maryland; J. E. Pennybacker, chief Division of Economics, United States Office of Public Roads, and E. L. Powers, editor of *Good Roads*. Charles P. Light, field secretary of the American Highway Association, has been loaned by the directors of that organization to the Pan-American Road Congress for work with the sub-committee on finance, of which James H. MacDonald is chairman. Mr. Light will also confer with city and county officials, commercial and road organizations and others interested in the road movement for the purpose of making known the character and scope of the annual Road Congress and to urge that strong delegations be named.

Colorado state highways will be discussed by J. E. Maloney, secretary and engineer of the State Highway Engineer, at the May meeting of the Colorado Association of Members of the American Society of Civil Engineers.

The convention of the American Water Works Association meets in Cincinnati, Ohio, May 10-14.

Personal Notes

Professor I. O. Baker, of the department of civil engineering of the University of Illinois, recently gave an address on "Selecting the Road Surface," before the students of the short course in highway engineering at the University of Michigan.

Professor A. M. Buck, of the railway engineering department of the University of Illinois, has been making an analytical investigation of the proportions of resistances used in electric railway motors. He has devised graphical methods which simplify the calculation of such resistances.

Funds have been authorized by the city council of Columbus, Ohio, for carrying out the recommendation of Jerry O'Shaughnessy, superintendent, and C. P. Hoover, chemist in charge, sewage disposal division, for adapting the original sewage sedimentation tanks to those of the Imhoff type. Plans for the same have been prepared under Mr. Hoover's direction by Mr. J. J. Morgan. These plans will be reviewed by a board of consulting engineers consisting of George W. Fuller, John H. Gregory and George A. Johnson.

Mr. James Shakman, formerly assistant chief chemist, bureau of streets laboratory, Chicago, has joined the staff of Walter H. Flood, consulting chemical engineer, 326 River street, Chicago, and has assumed the direction of the road materials laboratory which has recently been considerably enlarged. Mr. Shakman is a graduate chemical engineer, having received his degree from Armour Institute of Technology, and has had long experience in this line of work.

James Walker and George H. Cressler have announced their association under the firm name of Walker & Cressler, consulting engineers, with offices at 742 First National Bank Building, Chicago. Mr. Walker has been engaged in consulting practice in Chicago for ten years, being identified during that period with work in connection with the Chicago Elevated Railways Company, the Chicago surface lines, the Chicago Association of Commerce committee of investigation on smoke abatement and electrification of railway terminals, various electric railroad, lighting and power companies, and financial institutions interested in public utility properties. Mr. Cressler, for the past ten years vice-president and chief engineer of the Kerr-Murray Manufacturing Company, Fort Wayne, Ind., is a member of the American Society of Mechanical Engineers, American Gas Institute, National Commercial Gas Association, and several state and district associations. He has designed and constructed gas works installations in more than one hundred cities of the United States and Canada. The firm is now engaged in work embracing all phases of the relation of railway, gas and electric utilities to the investor and the public, including construction, operation, management, examinations, appraisals, reports, determination of rates and representation in connection with the exercise of public authority.

Louis E. Van Norman, of New York, has been selected as editor of *The Nation's Business*, the official publication of the Chamber of Commerce of the United States, published monthly in Washington, D. C.

Publications Received

An address before the American Economic Association at Princeton, N. J., December 29, 1914, by Samuel Untermeyer, of New York, on "Speculation on the Stock Exchanges and Public Regulation of the Exchanges," has been issued in pamphlet form.

National and State Revenues and Expenditures, 1913, and 1903, and Public Properties of States, 1913, U. S. Bureau of the Census, Washington, D. C. Paper. 44 pp. National and State Indebtedness and Funds and Investments, 1870-1913. Paper, 204 pp. Taxation and Revenue Systems of State and Local Governments. Paper, 275 pp.

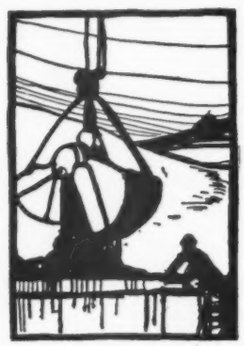
The Operation of Sewage Disposal Plants; a manual for the practical management of sewage disposal works, with suggestions as to improvements in design and construction, by Francis E. Daniels, A. M., director of water and sewerage inspection, Board of Health of the State of New Jersey. Illustrated from photographs by the author. Published by *Municipal Journal*, New York.

Weiss's "Preservation of Structural Timber." $3 net. McGraw-Hill Book Co., New York.

National Standard Hose Couplings and Fittings for Public Fire Service is the subject of circular No. 50 of the U. S. Bureau of Standards, Washington, D. C. W. S. Stratton, Director.

Concrete Pavements in Western Washington is a booklet of 37 pages compiled by Reitz, Story & Duffy, Inc., general engineers, Seattle, Wash., giving descriptions and costs of pavements laid since 1900 and the specifications for their construction.

George W. Perkins delivered an address on "The Outlook for Prosperity; Economics New vs. Economics Old" before the Economic Club of New York, which has been reprinted by the *Market World and Chronicle* of New York for distribution to those interested.



MACHINERY AND SUPPLIES

French Engineer Advocates Wire-Cut-Lug Brick

Wire-cut-lug brick has attracted considerable attention abroad and has been favorably commented upon by M. Vugnon, an eminent French engineer, in a series of articles profusely illustrated and published in the "L'Edilite Technique." M. Vugnon spent several months in the United States looking up the subject of pavements, with a view to a substitute for the expensive and, under modern traffic conditions, expensive and unsatisfactory roads of France. The visitor's attention was attracted by the wire-cut-lug brick advertisements, and he made a thoro investigation of this brick, its form and its uses, and he was so impressed that, upon going home, he wrote a series of articles, illustrated with cuts of wire-cut-lug brick and brick making machinery, and cutter, and views of city streets and country highways in America, highly extolling wire-cut-lug brick as a paving material and asserting that it was a practicable thing for use in France, both on account of the cost and its durability and for various other reasons. He entered very minutely into a discussion, giving cost data in detail, and dwelling upon the superiority of a brick pavement, and urging the manufacturing of paving brick in France. He said that the five principal reasons which point in favor of this type of road are "resistance, economy, ease of locomotion, appearance, cleanliness and hygiene." He declared brick pavements to be the ideal type of pavement, and he described the wire-cut-lug brick as the ideal type of paving brick.

The series of articles by M. Vugnon has apparently excited considerable interest and not a little comment in the French technical journals. This testimonial from an independent source, from an expert French engineer, who is comparing American brick highways and pavements with vaunted roads of France, to the disadvantage of the latter, both on account of expense and durability, is a high testimonial of American brick pavements in general and wire-cut-lug brick in particular.

Small Highway Culverts

J. W. Strack, county engineer, Spokane, Wash., has the following to say in *The Highway Magazine* regarding the use of corrugated pure iron pipe and concrete for culverts:

For a number of years I have been engaged in the construction of good roads, and the culvert question has been one of the most important, and, as a result, has been carefully investigated by me.

Like most engineers, I was prejudiced in favor of the idea that concrete was the proper material for culverts, and so started out to make all our standard culverts of concrete.

Right at the start I found that a question of economy entered; at prevailing prices in this locality it was cheaper to build culverts, with less than 4 square feet of area, of corrugated metal pipe.

The initial cost of a pipe culvert 30 inches in diameter, with an area of 4.9 square feet, was approximately equal to that of a concrete culvert having the same area, while a 24-inch diameter pipe was considerably cheaper than a concrete culvert of the same area.

However, the smaller sizes of concrete pipe apparently had some advantage as to price over the corrugated metal pipe, and I had a number of these installed. The result has been far from satisfactory; these concrete pipes are brittle and a sharp blow will shatter a section of the pipe; they are heavier and the cost of handling is consequently much greater than the corrugated metal. In case of a concrete pipe clogging up and subsequently freezing, the ends are almost invariably shattered, while corrugated culvert, under similar circumstances, would be elastic enough to remain undamaged. With the small amount of frost which we have in Spokane county the danger to the larger sizes of concrete culverts is negligible.

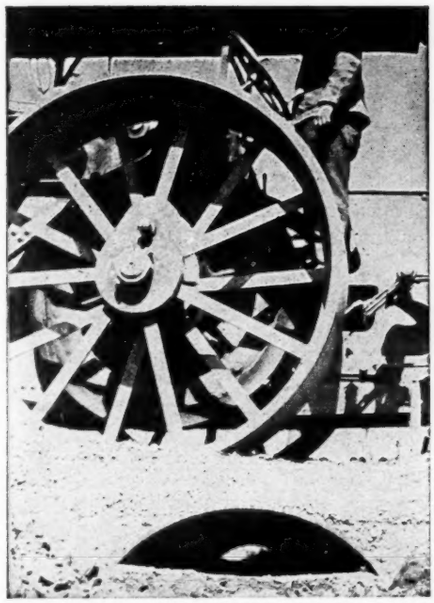
The objection frequently urged against concrete culverts, that of developing cracks which permit loss of water and consequent undermining of the culvert, is of minor importance. Deep cut-off walls on the upper and lower ends are necessary to prevent scour, anyway, and these will minimize the danger from leakage.

Care must be exercised in building concrete culverts, both in the selection of the materials and in the preparation of the subgrade to receive the structure. The building of concrete culverts cannot be left to inexperienced hands, and therein the metal pipe culvert has an advantage, for an ordinary "handy man" can lay a good pipe culvert without special training.

In some vicinities the condition of the soil and water deteriorates concrete. If there is any suspicion of the presence of alkali in either soil or water, concrete should be used sparingly and with great care.

Corrugated metal culverts are, I believe, the solution of the small culvert problem. They are easily installed by inexperienced men, their first cost is below other satisfactory construction, and, if made of proper material, they are durable. In cases where alkali or other detrimental materials are encountered corrugated metal gives the only durable culvert, and this material should be used.

In metals used for culverts I compel the sellers to furnish an analysis of their metals, showing the various impurities in them, and subject the material to further test if it is deemed advisable. These analyses are scrutinized for the presence of detrimental elements, particularly carbon, manganese, sul-



CORRUGATED IRON CULVERT, *part circle, showing the load it can carry when properly set.*

phur, silicon and phosphorus, and a maximum scale is adopted. If the analysis shows excessive impurities, the metal is rejected. This is, I believe, the common practice among engineers.

The design of these metal culverts is important. Certain forms on the market are too liable to crushing under the traffic and should be avoided.

I am convinced that for culverts from 8 inches up to 24 inches in diameter, or less than 4 square feet of area, pure iron culverts are the best from the viewpoint of both first cost and maintenance, while for culverts having an area of 5 square feet and over, concrete of proper design is advisable, unless local conditions show that concrete will deteriorate; then pure iron should be used up to a diameter of 6 or even 7 feet.

Koehring Catalog a Valuable Book on Mixer, Machine Placing and Crew Handling

The new catalog of the Koehring Machine Company, exclusive manufacturers of concrete mixers, Milwaukee, is being offered to contractors. This is in many ways of value to the concrete contractor, outside of its information and description of Koehring mixers.

The catalog itself is an unusually large one of ninety-nine pages, with cover printed in four colors, and inside pages in three colors.

It illustrates and describes the entire Koehring line:

Side loaders: 4, 7, 10, 12, 15, 20, 24, 30, 44 cubic feet.

Pavers: 6, 11, 18, 22 cubic feet.

Hot mixers: 10, 18, 20 cubic feet.

A special feature which will be especially valuable to contractors are the innumerable photographs showing Koehring mixers on the job. These photographs are large sized and show good detail of the contract. They offer an opportunity to study crew-handling, the placing of mixer, materials, etc., with a view of minimizing labor costs, and securing the greatest possible efficiency.

The catalog, of course, contains detailed descriptions of construction, of special automatic features including the Koehring batch-meter, of new features of side loaders which permit discharge to be controlled from four positions, two on either side of the mixer, increased leverage of discharge lever securing easier operation. It also shows new automatic knockout and brake on loading skip by which the loading skip automatically stops at charging position, and stays there until released. Another improvement, which has the importance of invention, is the power-driven platform-controlled distributing spout, by which the distributing spout is lengthened or shortened, or swung to any position by the operator on the control platform, with the same flexibility as the boom and bucket system. The spout maintains uniform distance from the ground at every point of delivery.

While the Koehring mixer, as described in the new catalog, remains standard in principal features, many improvements and refinements in detail have been made which add materially to smoothness of operation and low maintenance.

Machine vs. Hand Sweeping

The city of Litchfield, Ill., has conducted some tests with the pick-up sweeper manufactured by the Baker Manufacturing Company, Springfield, Ill., the purpose of which was to determine the relative cost of machine and hand street sweeping. The tests were conducted by Mr. Frank Hagerdorn, superintendent of streets.

The following description of the tests is abstracted from his report:

Hand sweeping creates, when streets are dry, as much dust as would be raised by sweeping with ordinary open sweeping machine, but as the dust created by hand sweeping is spread over a much greater length of time, it is not noticed nearly so much as the clouds that are raised by a passing open broom machine. Heretofore the brick-paved streets outside of a few blocks in the business district have been cleaned by hand with push brooms on an average of about three times each year.

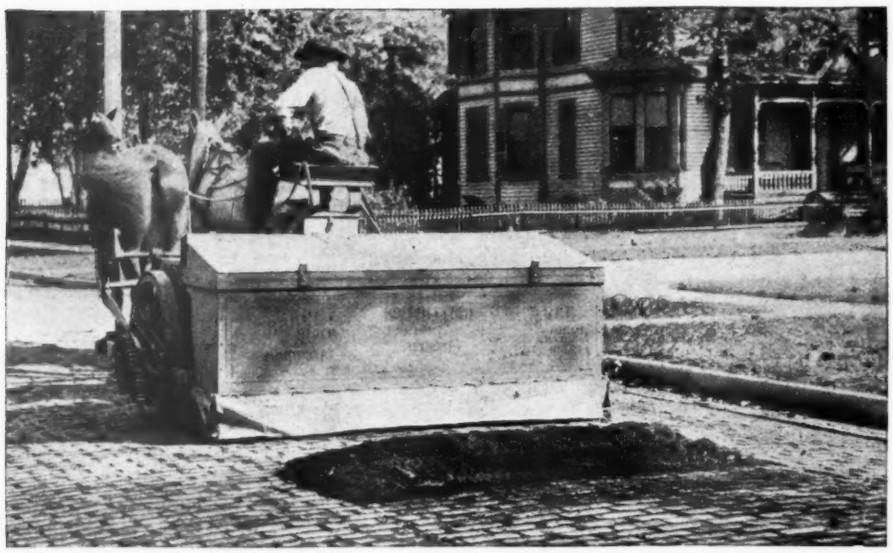
Sweeping by hand costs from 75 cents to $1.00 per block, according to the energy expended by men employed to do the work with push brooms, and a fair average estimate would be 85 cents per block. The Baker pick-up sweeper, on the operation of which this report is based, can be operated successfully with one team and driver, and will sweep forty blocks per day, at a cost of $4.00, the regular price for one man and team for city work, or at the rate of 10 cents per block.

What is termed the business district, cleaned daily, does not exceed six or seven blocks, there being seventy-three blocks of brick paving outside of that district. All hand sweeping is done without sprinkling and the comparative cost with the same work done by the Baker sweeper would be as follows:

Hand sweeping 73 blocks, at 85c per block	$62.05
Pick-up sweeper, 73 blocks, at 10c per block	7.30
Difference	$54.75
Saving, sweeping 73 blocks dry three times	$164.25

Light sprinkling, calculating the cost at the highest price charged by Mr. Bishop, will average 14 cents per block, which would make the total cost of cleaning by pick-up sweeper after light sprinkling, 24 cents per block, a saving over dusty hand sweeping of 61 cents per block. The saving on seventy-three blocks, one cleaning, would be $44.53, and on three cleanings per year, $133.59.

On the above basis the Baker sweeper would, used without sprinkling, more than pay for itself in three years, would save the street department much trouble and annoyance, would do better work in less time, would leave sweepings piled on street



BAKER PICK-UP *street sweeper in Litchfield, Ill., just as driver has operated the dump, showing pile of sweepings on pavement.*

so that much time could be saved in gathering and would not create any more dust than hand sweeping. With light sprinkling the Baker sweeper would save nearly its cost in three years, and would also save the expense of gathering sweepings and would entirely eliminate the dust nuisance.

In these estimates nothing has been allowed for the expense of refilling sweeper brush, as push brooms used for hand sweeping will cost more for the same amount of work than the refilling of brooms for Baker machine.

The above figures do not include the business district, and, in addition to the saving made as shown herein, a considerable amount should be allowed in favor of machine sweeping, as the machine can be used to great advantage in the business district. In figuring costs the expense of operating has been calculated at $4.00 per day for man and team, which is the regular price paid where team is employed for one day at a time. The cost of sweeping can be considerably reduced if arrangements can be made to employ a team regularly or if the city should provide its own horses for street work.

It takes one team eight hours to sweep forty blocks. It takes another team eight hours to clean up this dirt and haul it away to make fills. Sometimes it is hauled seven or eight blocks, but it is all cleaned up in about eight hours, so that it costs 10 cents a block to clean up the dirt and haul it away. The blocks are generally 300 feet square, not including the widths of the pavements. The streets are 60 feet wide, with 24 feet of pavement, except State street, which is 100 feet wide, with 84 feet of brick pavement. So figuring, the blocks would be about 324 feet long ordinarily.

When sweeping is done by hand the superintendent of streets, in order to secure good results, must give the work his personal attention, which prevents him from doing or looking after other work, and his salary, when hand sweeping is being done, should be charged against the cost of hand sweeping in addition to the figures shown herein.

The Baker sweeper will not only pay for itself within the time specified, but it will be a great advantage to the department, in that it will be able to keep the streets in much better condition than heretofore, and also because of the fact that whenever it is desired on special occasions to put the streets in perfect order the work can be done on short notice, and for further reason that after show or circus days, or the times when large crowds are present and the streets are littered with refuse, it will be possible for the department to clean up after midnight, so that the streets will be in good condition for the next day. This advantage is worth much, as it will remove one cause for complaint.

In connection with the street sweeping there should be used a light bottom-dump wagon for removing refuse and street sweepings without littering the streets, saving much time in dumping refuse as compared with ordinary leaky wagon beds and dump boards.

Efficient Lighting Service

On May 1, 1915, the Mitchell Vance Company became a part of Johns-Manville lighting service. Under this arrangement, the Mitchell Vance Company will devote its entire effort to the development, design and manufacture of lighting equipment, while the marketing of this product will be solely in the hands of the H. W. Johns-Manville Company thru its country-wide service-sales organization.

The real significance of this arrangement reaches further in the combined efforts of these two companies, for it establishes under one guidance three great divisions of lighting effort. For highly specialized and localized illumination the well-known Frink and J. M. Linolite systems of lighting; in aesthetic and commercial lighting the Mitchell Vance product, which for fifty years has figured in the lighting of America's representative buildings; linked with this the professional co-operation and installation service of the Johns-Manville Company thru its lighting specialists and construction departments thruout the United States and Canada.

Strengthening the Macadam Road to Meet Modern Traffic

For many years the navies of the world have seen a contest between the maker of armor plate and the gun. It began when the Merrimac sailed out before the fleets of the United States and let the cannon balls bounce off its iron-plated sides, whereupon all the naval guns in the world became obsolete.

So guns of higher power were created, which punctured the armor plate of that day with neatness and dispatch. Thereupon the armor maker produced heavier and stronger steel; whereupon the gun maker again produced more powerful guns.

A similar contest, as old as man, has been waged between the vehicle and the road. Thanks to the genius of MacAdam, there was a long period in recent history when the road

Baltimore and Washington Boulevard.
Treated with "Tarvia B"

40 miles of Tarvia Roads—

The great automobile boulevard between Washington, D. C., and Baltimore, Md., is tarviated from end to end.

The Tarvia treatment has given the road a firm, waterproof, durable surface—free from dust and mud—and one that is not affected by the wear and tear of swift motor car traffic.

Another great Maryland state road—the Baltimore-Annapolis Boulevard—also is tarviated for about twenty miles of its twenty-eight mile length, and results have been most satisfactory.

Owing to its very low cost and satisfactory results, the Tarvia form of road treatment and construction is growing more popular every year.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.
The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

BARRETT MANUFACTURING COMPANY

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Detroit Birmingham Kansas City Minneapolis Salt Lake City Seattle
THE PATERSON MFG. CO., Limited: Montreal Toronto Winnipeg Vancouver
St. John, N. B. Halifax, N. S. Sydney, N. S.

WEST WEBSTER STREET, *Chillicothe, Mo., showing condition of road before* **Tarvia** *was used.*

easily withstood the vehicle. The smooth, hard, macadam road, however, invited the development of the automobile and still more recently the motor truck, and macadam roads were doomed to swift and general destruction.

Now, however, the road is getting the better of it again, thanks to the development of the modern bituminous binders, of which Tarvia is the best known.

Many of the old macadam roads do not require rebuilding, and processes have been developed for applying Tarvia to the old surface in such a way as to preserve them from the ravages of modern traffic. In building new roads or rebuilding the old, Tarvia binders are used which are so strong that the stones are held in place, despite the efforts of traffic to dislodge them.

It is now ten years since these modern binders were introduced into this country, and the experience of many communities runs back over the whole period. In Newton, Mass., for instance, there is a section of Newton boulevard which was treated nine years ago with Tarvia, at a cost of 14 cents per square yard. The cost of maintenance of the whole Newton boulevard, subsequently all treated, comprising five miles of the heaviest traveled automobile road out of Boston, 60 feet wide, has been brought down to $1,200 per year. This includes cleaning and all work done on the surface of whatever nature.

Cleveland, Ohio, has a stretch on Bellflower road which was put down in 1905. It has been in service ten years.

Many other towns experimented with Tarvia in the early days, and have now settled down to the use of this material as a fixed policy.

Plainfield, N. J., is one of these, and it now has thirty-six miles of well-kept, tarviated road, the result of a consistent and economical policy that was inaugurated in 1908.

Another town is Westfield, N. J., with upwards of nineteen miles of smooth roads that have been maintained and made dustless with Tarvia at a very low cost.

Important parks and cemeteries have adopted Tarvia for their roads. The tarviated roads are clean enough and dry enough to use as walks, and at the same time the surface will withstand the transportation of heavy monuments. Graceland Cemetery, in Chicago, began in 1909 to tarviate its roads, and now has completed the treatment of its entire system.

Government engineers have been using Tarvia largely in the roads about Washington, the White House driveway having been maintained with this material since 1911.

Undoubtedly the use of Tarvia-reinforced roads is still only in its infancy. The automobile has already spread over the continent and the motor truck is fast following. The latter is already a serious problem in England and in some of the most congested centers of the United States.

The more efficient the motor truck becomes the larger loads it will carry and the greater will be the burden it imposes on the roadway. Motor bus and jitney, which threaten to become serious competitors of the street car, also bring their prob-

WEST WEBSTER STREET, *Chillicothe, Mo., showing condition of same street after Tarvia was used.*

QUALITY and SERVICE

YOU GET BOTH IN

BITULITHIC

This name stands for the finest monolithic bituminous construction that the ingenuity of man has yet devised. **Bitulithic** represents a high degree of **"Quality,"** renders unfailing "service."

We could build **Bitulithic** cheaper but we won't.
We would build **Bitulithic** better but we can't.

The integrity of the construction of **Bitulithic** and the satisfaction of municipalities which have and are still using it, far outweigh any saving in first cost.

Dartmouth Street, Boston, Mass., June 15, 1914, from Marlboro Street, looking toward Beacon Street.
Bitulithic surface, laid on old macadam foundation in 1903.

In these days of frenzied competition in the paving field, we believe this declaration of principle is needed. And our reputation of many years' standing in the street paving industry will back it up.

Bitulithic can be laid as satisfactorily over sound macadam foundation as over concrete foundation.

Do not hesitate—Investigate at once—Specify **Bitulithic** and have a pavement which is "built up to a high standard and not down to a low cost"—a pavement suitable under varying climatic conditions and all kinds of traffic.

Write today for illustrated booklets—it will be worth your while.

Warren Brothers Company

Executive Offices: BOSTON, MASS.

DISTRICT OFFICES:

NEW YORK, N. Y.	CHICAGO, ILL.	ROCHESTER, N. Y.	LOS ANGELES, CAL.	PORTLAND, ORE.	PHOENIX, ARIZ.
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lems. The public, since it maintains the right of way gratis, is interested in furnishing the new traffic proof surfaces.

Accordingly, it is easy to prophesy that plain macadam without bituminous treatment will become everywhere a thing of the past, as it has already in many localities. Unfit for modern traffic, it must be discarded in favor of roads that are firmly united by some plastic bituminous binder like Tarvia.

How to Clean Streets

Clean streets, how to best keep them clean in the most economical manner, is the subject of a new booklet published by Studebaker, of South Bend, Ind.

For over half a century Studebaker has been supplying the farmers of the United States with welcome information relative to stock, seeds, soils and the thousand and one things a farmer might be supposed to be interested in.

The new booklet gives city and county clerks, municipal engineers, street cleaning departments, boards of works, etc., a mass of statistical information about street cleaning which is bound to be just as valuable to the civic expert as Studebaker farm hints have been to the farmer.

The book deals with methods of keeping streets clean. Street sweeping, sprinkling, oil distribution on city and country roads, are all worked out in easily understood formulas and in such a way that the overworked city clerk or boro engineer can turn to its pages and get the information he seeks.

The number of square yards sprinkled by different types and sizes of sprinklers, the angles at which brushes of street cleaners should be set to get maximum results, and the easy conversion of water sprinklers into tree sprayers or oil sprinklers are discussed at length.

The detailed costs of street cleaning per square yard per year offer material for interesting comparison by any one who must keep watch over such expenditures. An important feature is the part devoted to the reports of a number of street cleaning departments. Here are collected in one place the conclusions of experts that one could get in no other way except by reading many volumes to find the important statistics the Studebaker compiler has arranged in a few pages.

While the information is primarily for municipalities, it also contains valuable information for managers of country clubs, race tracks and large estates. Dump wagons, automatic pressure oil distributers and gravity road oilers come in for distinctive treatment. There are parts of the book that cover particularly matters of interest to village improvement associations.

STUDEBAKER STREET SWEEPER *with sprinkling attachment, so that separate sprinkling cart is not required.*

Studebaker is distributing the book without charge to all who ask for it.

New Pavements for Old

Many communities have worn-out brick pavements which, while they are worse than useless as pavements, nevertheless afford an excellent foundation.

Street surfaces of this description can be made over into good pavements by placing a sheet asphalt or asphaltic concrete top on the old brick. Concrete pavements which, by cracking or disintegration of the surface, have reached an unsatisfactory condition can be resurfaced in the same way.

Resurfacing of this description, when properly done, provides a new pavement for the price of the asphaltic top.

The cost of reconstruction of this kind will, of course, vary with local conditions, but it will be far below the cost of a new pavement, even when the best asphalts are used.

It is the worst kind of waste to throw away the investment in old brick, concrete or even macadam highways, when these can be used as foundations for new pavements, which, at very moderate cost, can be made a big improvement over the old ones.

The Barber Asphalt Paving Company, Philadelphia, Pa., which has laid many successful asphaltic tops on worn pavements of brick, concrete and macadam, using Trinidad and Bermudez asphalts, gives the following instructions as to how the work should be done to produce the good results which they have shown are possible:

The first essential in work of this character is that the old pavement shall be thoroughly clean. Dirst must be not only swept from the surface, but removed from the cracks. This can be done with wire brooms. However this is done, it must be done thoroly. Use of a fire hose will ascomplish the removal of dirt even more effectively than sweeping, but if water is used the surface must be allowed to dry off thoroly.

Preparing the Old Surface.—Minor depressions in the old pavement may be brought up to a uniform contour by the use of binder (half-inch stone with about 4 per cent. asphalt cement), but no depressions of more than 2 inches should be filled in this way. These latter should be cut out and filled from sub-base to surface with hydraulic concrete.

The Paint Coat.—To secure perfect adhesion between the foundation and the asphaltic top, the brick or concrete should receive a paint coat composed of equal parts by volume of commercial naphtha and asphalt cement of 50 penetration, applied at the rate of not more than one gallon per square yard of surface.

Do not attempt to put this paint coat on a dirty or wet foundation. If a surface heater is available it will pay to warm up the street before the paint coat is applied. Dust or dampness prevents proper adhesion of the paint coat to the brick or concrete. Fill all depressions with concrete or binder as indicated; then clean and apply the paint coat.

The Wearing Surface.—As soon as the lighter parts of the paint coat have evaporated, and before it has had a chance to accumulate dust and dirt, the surface mixture should be placed and rolled. Either sheet asphalt or asphaltic concrete, each of 2 inches in thickness, may form the new wearing surface.

In cases where the curb is very low, and for this reason it is undesirable to make the wearing surface 2 inches thick at the curb, it may be reduced from 2 inches at the crown of the street to a lesser thickness at the curb. In one case where very successful resurfacing of this description has been done the asphalt top ranges from 2 inches at the crown to 1 inch at the curb; but so thin a wearing surface, even at the curb line, is not recommended as safe practice.

Neighborizing the Farmer

One of the most significant facts of our telephone progress is that one-fourth of the 9,000,000 telephones in the Bell System are rural.

In the days when the telephone was merely a "city convenience," the farms of the country were so many separated units, far removed from the centers of population, and isolated by distance and lack of facilities for communication.

But, as the telephone reached out beyond cities and towns, it completely transformed farm life. It created new rural neighborhoods here, there and everywhere.

Stretching to the farthest corners of the states, it brought the remotest villages and isolated places into direct contact with the larger communities.

Today, the American farmer enjoys the same facilities for instant, direct communication as the city dweller. Though distances between farms are reckoned in miles as the crow flies, the telephone brings every one as close as next door. Though it be half a day's journey to the village, the farmer is but a telephone call away.

Aside from its neighborhood value, the telephone keeps the farmer in touch with the city and abreast of the times.

The Bell System has always recognized rural telephone development as an essential factor of Universal Service. It has co-operated with the farmer to achieve this aim.

The result is that the Bell System reaches more places than there are post offices and includes as many rural telephones as there are telephones of all kinds in Great Britain, France and Germany combined.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

An Efficient Power Trench Tamper

In recent years there has been a constant demand from contractors, public service companies and others engaged in laying of pipe lines for a more efficient, convenient and cheaper method of tamping trenches. To meet this demand a number of tamping machines have been placed on the market or tried out experimentally. One of the latest and one of the most satisfactory machines of its kind is that which is manufactured by Pawling & Harnischfeger Company, Milwaukee, Wis.

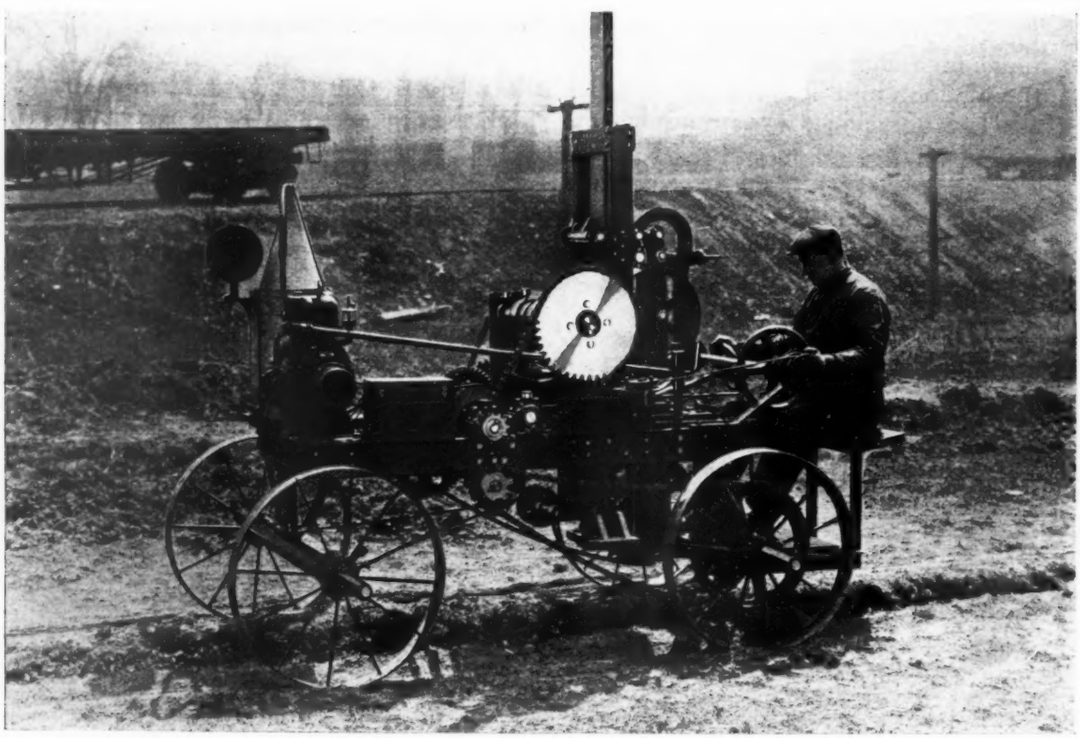
It is a power trench tamper, the wheels being carried on stub axles of steel which may be raised or lowered, throwing a leverage of 5 inches on either side from the center of the upright members of the main frame to which they are attached. This device makes it possible to keep the machine level even tho one wheel may raise 10 inches above the other. This adjustment enables the machine to be used satisfactorily on streets having a very steep crown or on curb and gutter bases.

The axles of the "P & H" power traction tamper are carried out far enough to allow for the widening of the wheel tread 12 inches on either side or 24 inches in all. The minimum tread is 4 feet 8 inches and the maximum 6 feet 8 inches.

The tamping head moves across the machine on a solid steel runway. The tamping head is 12 inches wide and has a maximum cross-travel of 20 inches enabling it to actually cover about 32 inches of trench. Since it is never necessary to tamp closer than 4 inches to the wall of a trench, the machine will handle a 40-inch trench. The tamping ram is operated by means of a large segment brought in contact with the hard wood ram by spring pressure on a large pulley on the opposite side of the ram. This segment is caused to revolve from 50 to 60 times per minute, causing a stroke of the ram at every revolution. This stroke has an average of 22 inches' travel, and the ram and tamping head together weigh 150 pounds.

The machine is operated by means of a 4-h.p., 4-cycle gasoline engine fitted with friction clutch pulley with 4-inch face, water cooled. The transmission is accomplished by means of friction clutches and chains. All high speed chains are of hardened steel. The steering gear consists of worm and wheel on cross-shaft steel cable connected to the front axle. A track speed of 1 1/3 miles per hour is provided for road travel, and this may be varied by changing the governor of the engine.

Full specifications and more detailed description of this machine are given in Bulletin No. 8 of Pawling & Harnischfeger Company, Milwaukee, Wis.



TRENCH TAMPER *made by Pawling and Harnischfeger, in operation on trench.*

A Perishable Dividing Plate for Expansion Joints in Concrete

A new invention has reference to improvements in dividing plates for expansion joints for concrete curbing and the like, and may also be used for sidewalk and other concrete work. Such dividing plates are usually of metal and temporarily inserted between two doncrete sections. When the concrete attains its initial or final set, the dividing plates are removed, whereby a slot is created between two adjoining concrete sections which permits of their expansion and contraction.

Recognition of the necessity of providing certain means for securing definite joints as a protection against possible damage to the concrete sections, due to expansion and contraction, led to the use of these so-called dividing plates. The dividing plates originally took the form of slotted metal strips about one-eighth of an inch thick. Some of those devices made of metal are held by long steel pins, which provide a rigid, accurate and durable means for separating the concrete sections. Flexible strips may be used for curves of any desired radius and means for making the form and dividing plates a single unit are known.

Concrete curbing, sidewalks, concrete roads, etc., are laid

1-Man Boulders!

530 Lineal Feet A Day-42" Wide 16 Ft. Deep Through Clay!

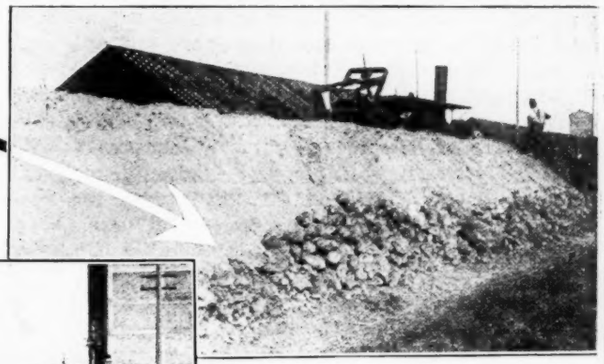


Photo above shows Austin Trenching Machine handling huge boulders, along with other hard material in the trench.

Photo at left shows a No. 1 Austin cutting 530 lineal feet a day—42 in. wide, 16 feet deep—through clay.

That's the kind of work users get out of their

AUSTIN Trenching Machines

If you have a machine of superior mechanical design like the Austin Trenching Machine, you can rest assured that you are not going to have any breakdowns on the job.

Among the highly-important advantages of the Austin Trenching Machine are: Multipedal Traction. Buckets dig full width of the trench instead of being attached to a weak, uncertain operating-boom which shifts laterally. The buckets dig by a powerful straight pull, which means the excavating of the maximum quantity of earth for the fuel and power expended. There is practically no loss of power through gears, from generation of power at boiler to point of actual digging. The use of belt eliminates breakages when obstructions are encountered.

Buckets are automatically self-cleaning by means of a positive mechanical method, enabling quick and efficient digging in any kind of soil.

Bear in mind that the AUSTIN is the machine that has made such low-cost season records as 3⅔ cents per cubic yard of material removed—also that it is built in nine sizes, and that we can most certainly take care of your requirements, whatever they are.

Write for a copy of Catalogue No. 106-A

F. C. AUSTIN DRAINAGE EXCAVATOR CO.

Railway Exchange, CHICAGO.

Pacific Coast Agents: P. B. Engh, Los Angeles, Pacific Electric Bldg.; San Francisco, Hooker-Lent Bldg. The Beebe Co., Portland, 186 W. Morrison St.

AGENTS WANTED FOR OPEN TERRITORY.

in sections of suitable length and not continuously monolithic for several reasons: First, to accommodate expansion and contraction of the concrete; second, to guard against breaking and damage in case of settlement of the sub-structure; third, to facilitate sectional construction without removing temporary obstructions in the right of way. The usual method employed to accommodate the foregoing is the employment of steel, wood or iron dividers, or, as they are called, dividing plates of suitable shapes and thickness, which are set or placed at intervals. After their removal the open joint or space displaced by it is filled with sand or other suitable material.

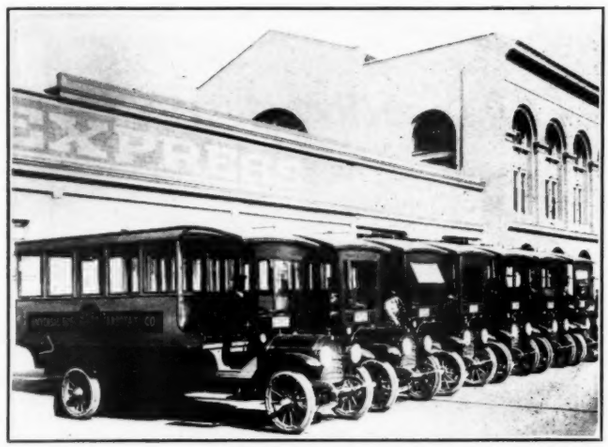
The disadvantages of this method are clearly shown when the following is considered: First, it is bad policy to leave the plates in position until the concrete has attained its initial or final set, as it may bond together. The removal of the plates then certainly becomes at times dangerous and troublesome. Second, the premature removal of the plates often destroys all edges, which have to be replaced after the forms are stripped. Third, it prevents a continuous, uninterrupted operation and saving of labor, as the forming as well as the filling of the joints with the filler can only be made after the concrete has become sufficiently hard or set.

It is the purpose of the present invention to overcome the described defects and to produce what I term perishable dividing plates, which deteriorate under atmospheric influences and crumble up so as to allow of expansion and contraction of the concrete sections, and the narrow opening formed by the deterioration of the perishable plate will be filled up gradually by dirt or dust which settles therein. Thus the novel dividing plates which are perishable will be applied between the concrete sections and will remain therein, so that no removal is necessary, whereby time and wages are saved. To attain this purpose the perishable plates consist of an organic substance such as sawdust, wood meal and the like, a mineral substance such as common sand, and a glutinous binding material such as water-soluble glue, gum tragacanth or the like. The proportions in which such materials are mixed may vary according to the time they are intended to stand and according to the atmospheric condition prevailing in certain regions. The sawdust or wood meal, for instance, is mixed with some fine sand and some powdered glue and the perishable plates are pressed into shape of the desired size. The surfaces of each plate are treated with an oily substance to prevent bonding with the concrete. Each plate may be made of one or more layers which are pressed or joined together to attain sufficient strength or stiffness. A perishable plate thus produced is sufficiently strong to act as a dividing plate and elastic enough in itself to accommodate expansion and contraction; in the course of time, however, by atmospheric influence and action it will deteriorate and leave the desired joint. The glutinous substance is dissolved and the sand and sawdust settle in loose form. In the case of a curb the desired opportunity for expansion is given. Similar action takes place in any joint so far as the destruction of the dividing plate is concerned, which leaves the joint open to receive whatever dirt may reach it.

The invention is put on the market by F. William Stocker, Inc., 1031 Clinton St., Hoboken, N. J., who deal also in protection bars, waterproofing and other appliances and materials for concrete construction.

Wireless Truck Tires on Exposition Busses

A fleet of ten Jeffrey 1½-ton passenger busses has just been put into service by the Universal Bus and Taxi Company, of San Francisco, for the accommodation of visitors. Seven of these are shown in the illustration.



FLEET OF TRANSPORTATION COMPANY'S
motor busses in use in San Francisco, Cal.

Each bus is fully equipped with Goodrich wireless truck tires—ideal for passenger service, inasmuch as they afford maximum resiliency and add materially to the comfort of the ride. Extra resiliency also relieves the mechanism of much of the shock it would otherwise sustain from unevennesses in the road, and means longer life to the vehicle as well as a diminution in repair bills.

When you reach San Francisco this year keep a lookout for a Universal bus, note the condition of the wireless tires, ask the courteous driver regarding the mileage already delivered, and then enjoy a restful, vibrationless ride.

Trade Notes

The Southwark Foundry and Machine Company, Philadelphia, Pa., will hereafter manufacture the Harris valveless Diesel engine which will be known as the Southwark-Harris valveless engine.

The Atlas Portland Cement Company is preparing to build a large new cement plant costing about $1,000,000, one mile east of Tippecanoe City, Ohio.

Keuffel & Esser Company, New York, have a new circular descriptive of their surveyors' duplex slide rule.

The Lynchburg Foundry Company have moved their general sales office from Lynchburg, Va., to Chicago, Ill., where they have located in the People's Gas building, with G. R. Johnson as general sales manager. Their pipe factories are at Lynchburg and Radford, Va., and Anniston, Ala.

The American Granite Company, Milwaukee, Wis., have just closed a lease of their Lohrville, Wis., quarries, the largest in the west, to the Universal Granite Company, 29 South La Salle street, Chicago, Ill., who will erect a new large crushing plant and go into the granite block and crushed granite business. The American Granite Company will take over the monumental granite business and continue the operation of their Red Wausau quarries and their Milwaukee plant. They report business very good.

A. D. Cook, Lawrenceburg, Ind., is now the manufacturer and selling agent of the Cook Well Company's goods, that company retiring from active business.

The Philadelphia Quartz Company, of Philadelphia, Pa., has extended the work of its Rocmac road department by opening a branch office in Harrisburg, Pa., with M. T. Calef, road engineer for the company, in charge, and one in Anderson, Ind., with B. E. Miller in charge.